Four Lectures

ON THE

NATURE, CAUSES, AND TREATMENT

OF

CARDIAC PAIN

Delivered at the Medical Graduates' College and Polyclinic in London on June 16th, 23rd, and 30th, and July 7th, 1902.

BY

ALEXANDER MORISON, M.D.

F.R.C.P. EDIN.

PHYSICIAN TO OUT-PATIENTS AT THE GREAT NORTHERN CENTRAL HOSPITAL AND PHYSICIAN TO THE CHILDREN'S HOSPITAL, PADDINGTON GREEN

Reprinted from THE LANCET, November 1, 8, 15, and 29, 1902.

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Indebted

TO THE INFLUENCE BOTH OF THE WORK AND PERSONALITY

OF

SIR WILLIAM TENNANT GAIRDNER, K.C.B.,

SOME TIME PROFESSOR OF MEDICINE IN THE

UNIVERSITY OF GLASGOW, AND DESTINED

TO BE A MEMORY OF THAT ANCIENT

SEAT OF LEARNING ALWAYS,

I respectfully inscribe these Lectures to him.

Four Lectures

ON

THE NATURE, CAUSES, AND TREATMENT OF CARDIAC PAIN.

LECTURE I.

Delivered on June 16th, 1902.

On the Anatomy, Physiology, and Pathology of Cardiac Pain.

Gentlemen,—It is by a happy accident that I find myself treating the subject of Cardiac Pain this year, for it is the centenary of the publication of the collected works of William Heberden—his "Commentarii de Morborum Historia et Curatione"—and we cannot honour the memory of that great clinician better than by an earnest study of the important affection with which his name will ever be associated. It might be regarded also by some as the centenary of his death which took place in 1801. For some reasons, it is to be regretted that when that great unifying force the Roman empire fell after a plutocratic degeneration into its component parts the nations which threw off the yoke of their effete conquerors had not the prescience to retain the language of Cicero and of Tacitus, of Horace and of Virgil. Had they done so it might have been possible for Frenchmen and for Germans, for Englishmen and for Italians, when Science had risen as a unifying force more powerful than the legionaries, to allot with greater justice and less grudgingly the meed of praise to scientific pioneers of other races than their own. These remarks are elicited by the fact that reputable French authors have of late endeavoured to snatch the laurel from the brow of Heberden and to place it on the head of their fellow countryman Rougnon who, a few months prior to the publication of Heberden's conclusions in 1768, mentioned in a letter to a friend the circumstances of the sudden death of a French officer. Rougnon's letter was written on March 18th, 1768, as has been satisfactorily proved by Dr. G. A. Gibson,[1] while

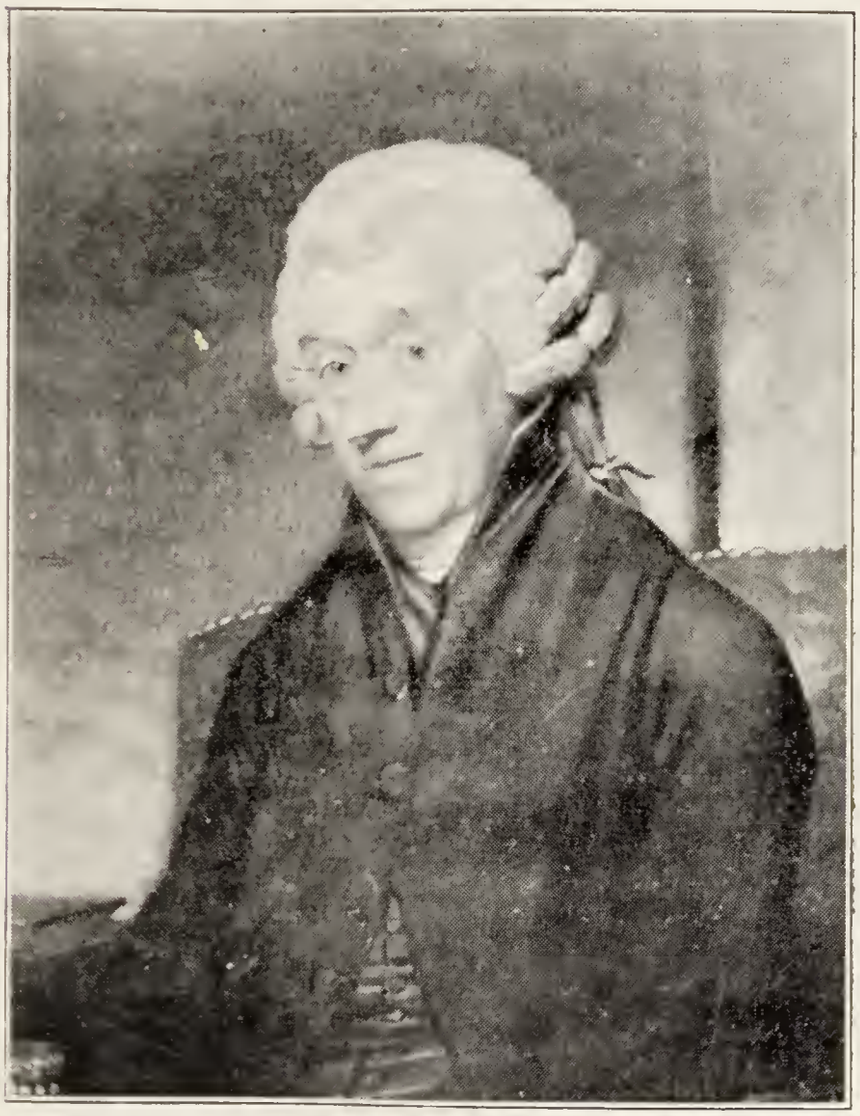
[1] Diseases of the Heart and Aorta, p. 758.

Heberden's conclusions were based upon a study of numerous cases and extended over many years prior to their actual publication.

I have no intention of occupying your time further with the bibliography of our subject, but have deemed it necessary, in view of the attitude assumed by some of our continental *confrères*, to vindicate the claims of him who wrote "De Dolore Pectoris" in so exhaustive a manner as to leave little for his followers in succeeding generations to do except, so to speak, to stroke his t's and to dot his i's. William Heberden was born in London in 1710 and died after a busy and reflective life at the ripe age of 91 years. The seventieth paragraph of his commentaries treats "De Dolore Pectoris." After dismissing as trifling other pains in the chest which he mentions cursorily, Heberden writes: "There is another kind of pain, which, not so much on account of its frequency, but because of its singular result, deserves to be described somewhat more fully; by it the chest is so distressed that it may justly be termed angina pectoris. Those who are attacked by this disease are wont to be seized with the most severe breast-pang while walking (most so if they walk up a steep incline and immediately after food), threatening the extinction of life, if it should increase or persist. As soon, however, as the pace is arrested all distress is quieted in a moment. At the commencement of this malady men can do all other things (*caetera omnia*); and from the disease itself those who are affected experience no difficulty in breathing, by which circumstance this breast-pang is chiefly distinguished. The pain very often extends to the left arm. Men are especially liable to it who have passed their fiftieth year. Its seat is sometimes the upper, sometimes the middle, and sometimes the lowest part of the sternum, not rarely, however, more towards the left than the right side. The pulses of those who are in this pain beat naturally (*naturaliter prorsus moventur*). After this plague has lasted for a year or longer it does not quiet down even when the patient is resting; it may then come on not only during walking but also when lying down, chiefly, however, in those who lie upon the left side, and thus it often compels patients to rise from bed. In some instances, but not in all, in which the disease has become chronic, pain is induced by carriage or horse exercise, by eating, coughing, defecation, speaking, or mental perturbation." After some other remarks in connexion with the malady Heberden quotes a case in which the pain was limited to the left arm, and notwithstanding this peripheral manifestation he had the acumen, from a study of all its signs, to associate the case with those more palpably evincing pain in the chest. The clinical picture is completed by a record of the sudden death of this patient. "The issue of this affection," he further remarks, "is noteworthy. For those who are affected by it all suddenly break down and die almost in a moment, if nothing occur to prevent the angina

pectoris reaching its acme."[2] There are points in Heberden's narrative, such as that asserting the unaltered beat of the pulse, which cannot be received without qualification and there is reason to believe that among the 100 cases of the affection which he thought he had met with many were not of that type which we have now learned to regard as "classical," yet it will be admitted that his general narra-

FIG. 1.



William Heberden.

tive is a masterpiece of accurate observation and correct inference, and I have quoted his remarks at some length because he is one of the worthies of the past whom it is a pleasure and duty to commemorate. (*Vide* Fig. 1.)

[2] Commentarii de Morborum Historia et Curatione. Londini, 1802, p. 309 et seq.

Visceral pain.—It is now a well-established fact in physiology that such circumstances as readily provoke pain in the somatic area of nerve distribution fail to do so in the territory of the visceral nervous system; organs may be touched, handled, and cut without the organism evincing any evidence of suffering. To this rule the heart is no exception. Physiologists teach us, indeed, that even normal subcutaneous textures such as tendons and muscles have little sensibility in a healthy condition. This general insensibility of the viscera is, however, conditional. In certain circumstances, as we all know, visceral pain of the most acute character may be experienced. The liver, which may be studded with nodules of malignant disease and cause the patient little discomfort, may also evince all the agony of hepatic colic. The intestines which may be exposed and handled without causing pain may be the seat of painful spasms from the moderate stimulation of retained material within them. The heart which may painlessly harbour a hydatid cyst for a length of time may evince on occasion such an agony of pain as to cause the sufferer to attempt self-destruction to escape from it. To some extent these differences in behaviour are probably due to a difference in the degree of stimulation necessary to provoke pain, but it is also probable that some structures entering into the formation of the viscera are more sensitive than others. The comparatively insensitive elements would in these circumstances require a greater stimulation to induce the expression of pain than those other more sensitive parts, and it has seemed to me, from a clinical consideration of the subject, that those parts of the viscera which have the least amount of yielding elasticity, such as the gland ducts, the blood-vessels, and the orifices of muscular organs, are more frequently observed to be associated with pain than other portions of the viscera. This normal comparative insensibility of the viscera ceases, as we know, if they are the subject of inflammation, and then stimuli which might otherwise be applied without provoking any suffering may give rise to much. This peculiarity of the viscera in the matter of sensibility is notably extended to the sphere of motion. The motions of the viscera are involuntary, beyond the power of the will, but, in proportion to this freedom from voluntary control, at the mercy of the emotions. These differences, together probably with the physical constitution of visceral muscle, seem to explain that peculiarity in the contraction of the latter which has been called attention to by physiologists—namely, the comparatively slow response of visceral muscle to stimulation, the cumulative influence of such stimuli, and their result in a prolonged and tetanic contraction or spasm.

Passing from these general remarks to the consideration of cardiac pain, let us shortly consider the factors and the conditions of these factors which underlie cardiac action

and a disturbance of one or other or one or more of which is at times associated with pain. The three factors which necessarily underlie cardiac action are: (1) the cardiac muscle; (2) the circulation of blood through that organ of constant activity; and (3) the nerves which control and regulate both the preceding factors.

The cardiac muscle.—The cardiac muscle is observed as an independent element at an early stage of embryonic life. It has been seen to contract rhythmically before it is penetrated either by organised blood-vessels or by nerves The last to arrive are the nerves. The muscle cell is thus the essential element in the muscular factor of cardiac action. It is the only visceral muscle cell which has a somewhat close resemblance to the cell of voluntary muscle; it is striated; and yet it has notable peculiarities of its own. The muscle bundles have no investing sarcolemma. The cells have a single nucleus more or less centrally placed. The striæ are less pronounced than in voluntary muscle. The cells branch, communicate, and interlace. These physical peculiarities place the cardiac muscle in a position midway between voluntary muscle and the plain muscle of other viscera and the blood-vessels. Difference in organisation is associated with difference in property and action, and while much obscurity still attends a knowledge of these processes there can be little doubt that the heart and vaso-motor system generally are affected by changes in the regulative mechanism of these structures or affect that regulative mechanism in a more palpable manner than is observed in other systems. In other words, the circumstances incidental to life, whether within the living organism or outside of it, reveal their effects with preponderant observability in the cardio-vascular mechanism of the body.

The coronary circulation of the blood.—The cardiac muscle is nourished in mammalians by the coronary arterial system which usually springs from two vessels arising from the aorta behind the two anterior pouches of Valsalva at the root of that vessel. These arteries sometimes arise by a common trunk and then divide into two main branches. At times, also, the heart is only nourished by one coronary artery and at others there are, as we shall have occasion to recall, three or even four coronary arteries. The place of origin of one or other artery may likewise vary, and Luschka cites a case in which the right coronary arose from the right subclavian artery.[3] The left coronary artery is almost invariably considerably larger than the right where it issues from the aorta and the pressure in it is consequently greater. Hyrtl affirmed that anastomosis did not occur between the two arteries and others have restated and stereotyped his opinion. In 1883, however, Dr. Samuel

[3] Anatomie des Menschen, 1869, p. 402.

West[4] determined by injecting hearts with carmine-gelatin that there was free anastomosis between the vessels and in the same year Dr. J. Wickham Legg independently came to the same conclusion and published his observations in the Bradshaw Lecture of the Royal College of Physicians.[5] Dr. Legg considered that the anastomosis was by way of the apex, not as maintained by some in the sulcus at the base of the heart. I was aware of Dr. West's general conclusions, but had forgotten the details of his experiment, when I recently investigated the matter for myself and was culpably ignorant of Dr. Legg's work until after my experiments were finished. Consequently, some points in my procedure differed from that of both these physicians, although the conclusions I arrived at were practically the same. The hearts of children I found most suitable for the investigation in consequence of the greater transparency of the epicardium and the absence of accumulated fat. Like Dr. West, I found hearts which had been kept in fluid for a time, so as to allow rigor mortis to pass off, were more easily injected than fresher organs. My experiments were made under hydro-pneumatic pressure in the ordinary manner and under warm water at 50° C. Gelatin variously coloured was the material used. The arteries were injected either simultaneously or alternately. The heart of a boy six years of age, who was accidentally killed, was simultaneously injected by way of both arteries—the left with carmine-gelatin and the right with ultramarine-gelatin. This done, the red tube—that tied into the left coronary artery—was allowed to lie loose in the water, while the blue tube—that inserted into the right coronary—was injected under pressure. Presently, fluid was observed to issue from the loose left tube, at first purple and then blue in colour ; the ultramarine-gelatin had reached the left coronary artery. The process was then reversed and the right tube was allowed to lie loose while the left coronary was injected under pressure with carmine-gelatin. Presently, the fluid issuing from the right tube was observed to become purple and then red ; the injection had reached the right coronary artery. To determine the *mode* of anastomosis the heart of an infant 16 months old was taken. The right coronary was ligatured near its origin and the nozzle of the injection apparatus was tied into the left coronary artery which was injected with ultramarine-gelatin. The whole heart, with the exception of a small portion near the commencement of the right coronary, where the ligature was placed, was injected, and, unlike Dr Legg, I found the anastomosis between the two vessels took place, not only by recurrent vessels ascending from the apex, but also by vessels which descended from the transverse sulcus and crossed in the sulcus on the posterior aspect of the heart

[4] The Lancet, June 2nd, 1883, p. 945.
[5] Medical Times and Gazette, 1883.

from the left to the right main trunk. On the whole I found injection of the coronary circulation by way of the artery on the left more easy than by way of that on the right. Nor was the permeation of the injected material limited to the heart only, but travelled upwards in the intervascular cellular tissue and helped to nourish the coats of the large vessels, especially those of the pulmonary artery in my preparations. This ascending distribution of the coronary vessels probably establishes communication with other branches of the aorta, especially the bronchial arteries, a circumstance which may in some instances be an important factor in maintaining the nutrition of the heart.

Thus, Dr. West's and Dr. Legg's experiments, of which my own may be regarded as a repetition and confirmation, show beyond cavil that the arterial system of the heart anastomoses freely. This freedom of communication on the arterial side is matched by the collateral pliancy of the coronary venous system, as shown by a remarkable case published by the late Dr. Moxon of Guy's Hospital in the Transactions of the Pathological Society of London.[6] The case was that of a young man, 19 years of age, in whom the main coronary sinus was quite obliterated by the pressure of a hydatid cyst, at a point near the normal entrance of the sinus into the right auricle. Notwithstanding this obstruction at so essential a point the cardiac muscle showed no undue venosity, and a committee appointed by the society determined that the blood had returned freely to its appointed destination by way of the foramina of Thebesius in the right auricle. Free as is the provision for circulation through the walls of the heart, Dr. Sibson observed[7] that during systole arteries and veins alike became turgid and subsided during diastole. This is evidence of momentary pressure on the smaller arteries and closure of the coronary sinus in this phase of the heart's action and of the forward bound of the blood stream during diastole, at which moment, also, the recoil of blood on to the aortic cusps plays the part of valves at the arterial orifices of the coronaries and urges forward the momentarily impeded column. In his Bradshaw Lecture already mentioned Dr. Legg recorded the result of experiments in which one or other, or both, coronary arteries had been ligatured during life. The general experience of those who performed these experiments appears to have been that while ligature of both vessels was followed by cessation of cardiac movement within a slightly shorter period than when only one was tied the effect of the single ligature was quite as deadly. An older writer (Chirac) seems to have been the only dissentient from the general opinion, while Cohnheim, likewise quoted by Dr. Legg, found that ligature

[6] Vol. xxi., pp. 99–100.
[7] Medical Anatomy, p. 73.

of one vessel caused sudden cessation of the heart's action in 100 seconds. In view of the very free circulation in this system which has been shown to exist this result is difficult to explain on a purely hæmic hypothesis. That death should be the result from this cause when both vessels are ligatured we can readily admit, for the hæmic factor is then quite, or almost quite, cut off, just as we shall learn presently that death occurs when both vagi (not one vagus) are divided, but that one vessel should kill on this hypothesis is not probable. I would suggest that in this case the ligature not only cuts off blood but produces pain by the severe constriction of neural elements and that the heart in a measure is placed in a condition of painful inhibition and that the animal dies from a species of angina pectoris.

The blood.—We have touched upon the nature and conditions of the blood-vascular system of the heart. The importance of the quality of the blood itself must be emphasised and the beautiful and necessary provision mentioned whereby the incessantly active organ, by the short-circuiting of the coronary system within the larger cycle of the systemic vessels, is constantly supplied with the very first of the newly oxygenated vitalising fluid. Indeed, while it is customary to speak of the pulmonic as a modified system in the circulation from its intrinsic peculiarities, and of the portal system as distinct for the same reason from the general systemic arterio-venous circulation, but of the coronary vessels as merely a portion of the latter, I think that it might be argued that the intrinsic peculiarities of the circulation through the heart, while they cannot place it in a category apart, justify our using the term "coronary system." Our knowledge of the share taken by the lymphatic system in this connexion is too imperfect for fruitful discussion in this place. All the anatomical and physiological facts, however, which have been so cursorily mentioned have an important bearing on the pathological and etiological questions which we shall have to consider later.

The cardiac nervous system. — The nerves of the mammalian heart spring from the trunk of the vagus and from the inferior cervical ganglion of the sympathetic chain. The trunk of the vagus is, however, a mixed one and contains fibres of the spinal accessory nerve which avoid the jugular or root ganglion on the vagus, and passing through its lower or trunk ganglion course to the heart in the vagus. These are said to be of small calibre, like all efferent visceral spinal nerves, according to Gaskell.[8] The sympathetic spinal nerves of the heart are derived from the upper dorsal spinal nerves, from the second to the fourth and perhaps the fifth, but chiefly from the second and third—

[8] Journal of Physiology, vol. vii.

probably not from the first. The gathering point for these spinal cardiac nerves in the thoracic chain is the stellate or first dorsal sympathetic ganglion, issuing whence they encircle the subclavian artery as the so-called ring of Vieussens and thence by way of the lower cervical ganglion pass to the heart. Both vagal and sympathetic branches from either side having approached or reached the organ contribute to the superficial and deep cardiac plexuses. The principal site of the cardiac plexus is between the aorta and pulmonary artery below the ductus arteriosus, while subsidiary portions lie thick on the basal segment of the heart. Anatomy teaches that a greater number of branches of the vagus reach the cardiac plexus from the right than from the left nerve. In the cardiac plexuses, in all probability, an incomplete peripheral decussation of nerve fibres occurs—that is, nerves from either side supply both halves of the heart. This seems to be proved by the fact that section of the vagus on one side does not materially or permanently disturb the heart's action, while division of both nerves soon proves fatal.

The majority of the medullated fibres of the vagus lose their medulla in the cardiac plexuses ; the majority of the medullated fibres of the spinal cardiac nerves theirs in the ganglia of the sympathetic chain which intervene between their point of issue from the cord and their exit from the inferior cervical ganglion. For our anatomical knowledge of these important facts we are largely indebted to Gaskell of Cambridge and subsequent workers in this country and abroad. Kölliker[9] of Würzburg affirms his belief that nerves which retain their medulla in the visceral periphery are afferent and therefore sensory, as they pass through or over intervening ganglia without being demedullated and dispersed by them. On the visceral distribution of efferent branches of both the vagal and sympathetic series ganglion cells occur, in larger or smaller groups, and as the function of the two main streams of innervation differs their respective ganglion cells probably remain essentially as distinct as the nerves themselves, however much they may be agglomerated. The ultimate distribution of the nerves to the cardiac muscle is, as in other organs, by fine nucleated plexuses which end upon muscle cells both cardiac and vascular. In the opinion of most histologists they do this by so-called free-ends. Such an arrangement would seem to be necessary to the exercise of the separate functions of the two sets of nerves. This muscle cell seems to be the ground common to both and it is the probable medium of interchange between them by chemico-physiological processes which can at present only be surmised. By means of this neural mechanism, then, the regulated action and nervous nutrition or trophation of the heart are secured.

[9] Gewebelehre, p. 858.

Although the embryonic heart has, as has already been mentioned, a rhythmical action before it is supplied either with organised blood-vessels or with nerves, the conditions of sustained rhythmicality, especially in the higher animals, seem to require an integrity of all three factors in cardiac action—namely, the muscle cell, the blood which bathes it, and the nerves which regulate and, in some way at present unknown, exercise a trophic influence upon it. By means of its nervous endowment the heart may be retarded or even arrested in action—that is, inhibited ; quickened in rate and in force or augmented ; and weakened or depressed. The channels for inhibition, depression, and trophation are contained in the vagus ; those for acceleration and augmentation in the sympathetic spinal nerves. The spinal accessory fibres already mentioned as coursing in the vagus are now regarded as the inhibitory fibres and are efferent in action towards the heart. The depressor fibres (the nerve of Cyon) exercise their influence *from* the heart by way of both ganglia on the vagus at the vaso-motor centres in the medulla, whence they induce a fall in the peripheral blood pressure. They are, therefore, afferent or sensory in character. The direction of the trophic influence, of which we are justified in assuming the existence, is probably efferent. Sensory and motor fibres likewise exist in the sympathetic spinal nerves and constitute the peripheral mechanism of augmentation. They are, indeed, believed by some to be the chief seat of cardiac sensibility, and the character and distribution of radiated pain in sensory disorders of the heart support this view. The general effect of retardation of the heart is regarded as conservative of energy and is termed "anabolic"; that of acceleration and augmentation as expending energy and tending towards exhaustion and is said to be "catabolic." Finally, by paths not yet determined, the cardiac mechanism is in connexion, like the rest of the body, with the higher centres and, like the rest of the viscera, manifests its freedom from the control of will and its domination by the emotions. The phrenic nerve arising from the fourth and fifth cervical spinal roots and sometimes establishing touch with the sixth cervical and with lower portions of the sympathetic in its passage towards its chief distribution—namely, the diaphragmatic muscle—may be mentioned to complete the narrative of cardiac innervation. According to Luschka[10] it gives a branch to the right auricle. Lying close to the pericardium in its descent towards the diaphragm, it may possibly be responsible in a measure for some of the anginoid pains associated with inflammation and tumours in the chest.

The pathology of cardiac pain.—As a general term "cardiac pain" should include all pain arising in or near

[10] Quain's Anatomy, vol. ii., p. 2.

the heart, the frequently very slight personal discomfort of a weak or uncompensated heart, as well as pain provoked by inflammation of one or other texture of that organ, or caused, as happens in some instances apparently, by external pressure exercised upon it or neighbouring structures by growths or aneurysmal tumours. We have seen, however, that the heart itself may be subjected to much disturbance of this character without exciting pain as a predominant symptom. With the exception of aortic valvular disease, to which special reference will be made in its own place, endocardial lesions are rarely, if ever, the cause of that agony which has gained the designation of "angina pectoris." In using the term "cardiac pain," therefore, I shall chiefly refer to the latter. The terms are almost equally indefinite and I should prefer to them that of "Heberden's disease' were it not that there are objections to a patronymic nomenclature, and Heberden's honoured name has already been coupled with nodes on the distal phalanges of the fingers. It is natural that effects should obtrude themselves upon our notice and enter into our nomenclature of disease when causes are unknown or disputable. The ancients were temporarily content with such a term as "dropsy." We have to employ such expressions as "arthritis deformans," "exophthalmic goitre," or "angina pectoris." Minute research, which is the chief engine of scientific progress, will doubtless in time relegate all such expressions to the museum of words which mark the advance of medicine to more definite knowledge, but that time, in the matter of cardiac pain, is not yet. It seems presumptuous, indeed, to say so, but it can with all modesty be truly asserted that the heart has rarely, if ever, been thoroughly examined post mortem. Personally, I have never examined the organ sufficiently thoroughly to satisfy myself. If its general proportions and gross lesions have been noted, in many instances its microscopic structure and vessels have been left uninvestigated. If the latter have been more or less examined the character of its nervous regulative apparatus has been overlooked. If, again, it has been attempted to throw light upon the latter the matter has not been exhaustively dealt with—cannot, indeed, at present be satisfactorily dealt with because it is still very obscure. Indeed, the time necessary for such investigations is not at the disposal of the general pathologist and specialism in research as in practice will most probably find a place in the near future. Already, indeed, the Pathological Society of London, the one recognised court of appeal in which used to be the Morbid Growths Committee, has at least four sections, and it may safely be asserted that at no distant date these also will be subdivided. In these circumstances the sketch I propose giving of the pathological conditions associated with cardiac pain must of necessity be imperfect, but there are one or two points in connexion with this matter upon which I hope to throw some light which, to me at least,

is new and appears to be not without interest. The heart, as a whole, of those who die during an attack of cardiac pain is perfectly flaccid when the body is opened and exhibits *primâ facie* strong justification for Parry's use of the term "syncope anginosa" as applied to these cases. The cardiac muscle in cases which die thus is at times found to be well preserved, even in circumstances which at first sight seem well calculated to induce degenerative changes. I throw on the screen and have placed under the microscope sections from such a case which was not alone interesting in this particular, as we shall presently learn. The striæ will in places be found to be well marked, the nuclei well preserved and speaking generally exhibiting little evidence of granular or fatty degeneration. But, on the other hand, in cases well supplied with pervious and comparatively elastic arteries, the muscle cell may manifest well-marked evidences of fatty degeneration in association with, or independently of, fatty infiltration of the textures—that is, the dissection and rupture of muscular fibres by the penetrating growth of a surplus of fat cells. Of the latter, I show you likewise a good example, from the heart of a man who died in his first serious attack of angina pectoris. The surface deposit of fat in such a heart is also shown by the transparency which was made from a photograph taken of the same heart shortly after death. Some authors have noted a peculiar change in the muscle fibres of those who thus die, and, indeed, in others who have died from various causes. It consists in a minute division of the muscle fibres transversely and has been termed "fragmentation." As we know, the cells of cardiac muscle are joined end to end by transverse junctions, an arrangement calculated to facilitate such fragmentation. It is possible, therefore, that this condition may in part be the result of ante-mortem contractions or of post-mortem rigidity, but I am inclined to believe that it is most frequently artificial and the result of various hardening and desiccating processes. I show a section from a fatal case of angina the condition of which I attribute largely to the use of osmic acid in preparing the specimen. I have, however, noticed this phenomenon when that agent has not been employed.

The coronary arterial system plays an important rôle in the pathology of angina pectoris, and yet a very puzzling rôle, like every other structure in connexion with that very inadequately investigated subject ; for the grossest atheromatous and calcareous change may be met with in these vessels without their having elicited during life any feature in the syndrome of angina pectoris. Why this is so only future and more careful investigation will fully reveal, but I hope to lay before you a contribution to that clearer light presently. The atheromatous change in the coronaries is a very striking and important phenomenon. If transverse sections be made of a healthy coronary artery in a young

adult a certain standard proportion may be observed in the relative thickness of its layers or coats. The membrane of Henle, separating the subepithelial from the muscular coat, is the important guide to the histologist and the measure whereby we may determine the degree of the thickening which the vessel has undergone—in other words, the amount of elasticity of which the nutrient vessels of the heart have been robbed. Comparing the normal specimen which I show you and which I obtained from the right coronary artery of a well-developed male, 19 years of age, who died from appendicitis, with that of a man who died at the age of 63 years from angina pectoris, two general facts will be observed—namely, that the subepithelial layer in the healthy young man bears a very small proportion to the thickness of the muscular layer, while in the older man who died from angina the subepithelial layer is much thicker than the muscular, the whole artery being less elastic and the muscular layer hypertrophied when compared with that of the standard mentioned—in consequence of the greater difficulty thrown upon the vascular muscle to contract upon its less yielding sub-structure. If, again, the latter specimen be compared with the atheromatous coronary which I also show you, taken from a man, aged 54 years, who died from angina pectoris and in whom the atheromatous change was associated with a rigid calcification of the walls of the artery, which in great measure must have prevented the main trunks of the vessel from contracting at all, it will be observed that while the sub-epithelial greatly thickened layer exhibits well-known atheromatous changes the muscular coat, unlike that of the uncalcareous but hypertrophied artery, is not thicker but thinner than that in the healthy young man taken as a standard. At places also this seems directly due to the pressure of atheromatous nodes. In order that I might prepare specimens of this calcified artery I found it necessary to immerse the portion selected, which like the others was taken from the vessel on the right, in dilute hydrochloric acid for nearly a fortnight, in order to decalcify it, and I would suggest that all the rigid coronaries in cases dying from angina pectoris and in those not so dying should be similarly treated and carefully examined by serial or, at least, numerous sections, in order that the mysterious fact may be cleared up why some calcareous coronaries are associated with the syndrome of angina and others are not. In the case from which this vessel was removed there were constant attacks of angina for a length of time before the fatal seizure and in all circumstances as to rest or activity, and yet there was nothing in the calcareous vessel externally to distinguish it from other calcareous arteries unassociated with cardiac pain. But on microscopic examination I discovered one fact which I consider of great interest, although I do not positively state that it was necessarily the essential or only cause of the angina. It would, however, be quite as difficult

to prove at present that it was not. I was fortunate enough to obtain three sections illustrating this point and I think you will agree with me that the specimens I exhibit show in a very instructive manner the mode of formation of an aneurysm before it has eroded the muscular coat of the vessel and become evident externally. (*Vide* Figs. 2 and 3.) It will be observed that the internal layer of the vessel has been pushed before the eddy in the blood stream at its com-

FIG. 2

Dissecting aneurysm of the right coronary artery. The wall of the vessel decalcified, its lumen containing thrombus. Occ. 4, obj. $\frac{1}{3}$ (Swift's).

mencement and that this diverticulum in the stream has been dammed in by protective and proliferative processes in its passage through the connective tissue layer, until its outer encapsuled end lies in immediate contact with the muscular layer. How many more of these saclets there might have been in the vessels I cannot, of course, say—perhaps no more—but the discovery of one argues the possibility of others. In the immediate neighbourhood of the sac there are encapsuled spaces filled with blood which resemble

sections of veins but which appear to be portions of the same aneurysmal process—portions, that is, of a dissecting aneurysm. I have looked through the indices of the Transactions of the Pathological Society of London from the first to the last volume and find no mention of such a condition. Nor have I found any record of it elsewhere. It is of interest that this instance occurred in a prolonged and severe case of

FIG. 3

The head of the same aneurysm more magnified.
Occ. 4, obj. $\frac{1}{8}$ (Swift's).

angina pectoris. It may have a bearing on the explanation of pain in some cases ; it may not. The future must decide this point, but in the meantime I regard it as very probable that intravascular aneurysm is one of the causes of angina. As we shall learn, when we consider the clinical history of angina pectoris, there are cases in which the neural element of pain—for pain can only be a property of the nervous

system—is the predominant feature and the cardiac failure in all probability precipitated by it; and another class of case in which the apprehension of cardiac failure, the sense of impending death, is associated with little or no local cardiac or referred pain. It is probable that these cases, differing from one another in so important a particular, differ likewise in the details of their local pathology. The hæmic factor, without local laceration or disturbance of texture, as in the instance I have related, may, it is surmised, play a predominant rôle by temporary, that is, claudicatory, occlusion of a vessel or vessels on the hypothesis first suggested by Allan Burns of Glasgow, or by thrombosis. Certain it is that the coronary vessels may become thrombosed, but claudication is at present merely a hypothesis based upon argument from analogy, the analogy being drawn from vessels in other parts of the body.

I shall later have a few words to say on the subject of so-called "angina sine dolore" and may, with all due respect to those who think otherwise, call in question the right of some of these cases to be classed with Heberden's disease. But to determine this point also, much more minute investigation must be made than has hitherto been the case. That cases of coronary atheroma are numerous, and of angina pectoris rare, has been remarked by nearly all writers on the subject, but it is equally well known that cases of aortic atheroma are much more common than cases of aortic aneurysm. Moreover, even all conditions of aortic aneurysm are not equally associated with pain, but there are few cases of aortic aneurysm in which there has been no pain at some time or other, however that circumstance be explained. Professor T. Clifford Allbutt has likewise emphasised the relation of aortitis to angina pectoris and even suggests that evidence supports the view that "the seat of anginal pain is not in the heart, as every writer seems to suppose it to be, but in the aorta."[11] Sir William Gairdner and other physicians of note, as we shall learn later, have also called attention to pain as a symptom in connexion with aortic disease. From Professor Allbutt's opinion that all classical cases of angina pectoris owe their origin to extra-cardiac causes I shall find it incumbent upon me in the course of my remarks to dissent, but the views of the authorities I have mentioned necessitate a short examination of the degenerative changes in the aorta, while discussing the pathology of angina pectoris.

It will be remembered that while inquiring into the conditions of the coronary circulation it was mentioned that the circulation through the nutrient arteries of the heart was systolic in time and aided by the diastolic tension of the aorta when the propulsive phase of ventricular action was at

[11] Selections from the Lane Lectures. Reprinted from the Philadelphia Medical Journal, Jan. 27th, 1900, p. 124.

an end. There is thus the brunt of a double impact expended upon the commencement of the thoracic aorta and especially that portion of it whence the coronary arteries spring. It is therefore in no way remarkable that the aortic intima should in these situations show in a very large number of cases which have approached or passed middle age the evidence of wear and tear—that is, of atheroma and its associated processes. The conditions of atheroma, while essentially the same here as those already described in considering the coronary branch, are also modified to some extent, in obedience to the histological differences involved and the greater blood pressure to which the larger vessel is subjected. The inner coat in this vessel, as is remarked by Coats and Auld in their instructive memoir on the subject,[12] is relatively thicker and the delimination of the inner from the middle (muscular) coat less strict than in smaller arteries. Hence there is a somewhat greater difficulty in separating the consecutive stages of the conditions, essential and accidental, from one another. These authors agree with Virchow in regarding the process as a whole as inflammatory, but do not exclude a certain conservative function in the proliferation of connective tissue which it entails. "The lesion in the intima is," according to Coats and Auld, "a reduplication of its own tissues." Atheroma is, in its essence, an overgrowth of connective tissue in the inner arterial coat, usually arising in an insular or disseminated manner in the form of nodes or patches, and tending to degenerate in these foci and to produce retraction of tissue in inflamed areas. Hence, among other effects, the narrowing of the coronary orifices behind the pouches of Valsalva. Coats and Auld are equally instructive on the production of aneurysm in the aorta, and show from its small beginnings to its ultimate penetration of all the coats of the normal vessel how the process commenced in the intima as a rule and, followed by depression or cupping of the intima, presses on to, and perforates, the muscular coat, until the latter forms but the collar to the neck of the sac. I have said, as a rule, for Coats and Auld discuss the question of a primary rupture of the muscular coat, a condition which is actually observed under the microscope in association with proliferation which is in a measure a protective overgrowth of connective tissue. It is feasible to suppose, as they suggest, that in a weakened vessel subjected to so great an impulsive pressure of blood as is the case in the aorta such rupture may occur and be the initial step in the series of changes which lead to the ultimate extra-vascular bulging, when the sac itself is chiefly formed of the thickened and inflamed adventitious coat, the very arteries of which may reveal an obliterative endarteritis.[13] But a process such as this is not probable in the

[12] Selected Researches in Pathology, by A. G. Auld. J. & A. Churchill, 1901, p. 109. [13] Op. cit.

coronary arteries themselves. Here, as the specimen I have shown you very well reveals, the aneurysm is evolved more on the lines of the so-called "atheromatous ulcer," a depression in the endothelial layer pressing towards a softened area in the intima, bursting into it, and encasing itself as it pushes its way towards the media, in a capsule begotten of proliferative arteritis, there to pulsate against and ultimately to destroy the muscular coat and in all probability in the process to cause the organism pain. Such, then, is the history of the slow attack, invasion, and overthrow of the ramparts against destruction in an artery by the eroding forces which are inimical to its life but which are of necessity factors for a time in the life of the organism. To exist is to wear and to wear is to tear. But in association with cardiac pain attention has been called especially by Professor Clifford Allbutt to an acute aortitis—an acute inflammation especially of the lower segment of the ascending portion of the thoracic aorta, and I shall postpone a more detailed consideration of this important subject until I come to discuss the clinical history of what I have termed "aortitic angina," because one of the best descriptions of the condition with which I am acquainted is given by M. Huchard, whose interpretation of the phenomena I shall find it incumbent upon me respectfully to dispute and to whose work I shall refer.

In connection both with the acute and chronic changes in the aorta and coronary system we may have inflammatory and proliferative changes in the aortic cusps due to rheumatic endocarditis in its simple or so-called malignant or ulcerative forms, or, as is argued by other evidences of the disease elsewhere, to syphilis. I shall also have occasion, when discussing the clinical history of the disease, to instance a remarkable case in which a gigantic ulcerative endocarditis affected the pulmonary arterial valves and portions of the pulmonary artery. So much, then, for the vascular changes in connexion with cardiac pain. The blood itself is in many cases normal for the age of the patient but may be spanæmic from one or other dyscrasia, such as paludism, gout, or lead poisoning.

Trustworthy observations on changes in the cardio-vascular nervous system in association with angina pectoris are not numerous. Huchard[14] mentions the names of Gintrac, Corrigan, Lancereaux, and Loupias as having treated of neuritis of the cardiac plexus, of Peter as having met with this condition in association, not only with neuritis of the plexus, but also of the phrenic nerve, and of "Putjatin, Uskow, Hoffman, &c.," as imputing angina pectoris to inflammation of the cardiac ganglia. The detection of the ultimate distribution of the cardiac nerves to the muscular fibres of the heart is a difficult matter, even in the fresh tissues of recently killed animals, while

[14] Maladies du Cœur et des Vaisseaux, 1893, p. 598.

their state in the human cadaver is, so far as I am aware, unknown. In Lancereaux's case the cardiac plexus participated in an extremely rich abnormal vascularisation at the root of the aorta and showed microscopically a round-celled infiltration between the nerve fibres of the ganglion which compressed these. These conditions were associated with angina pectoris. Previously to his observations the neuritic

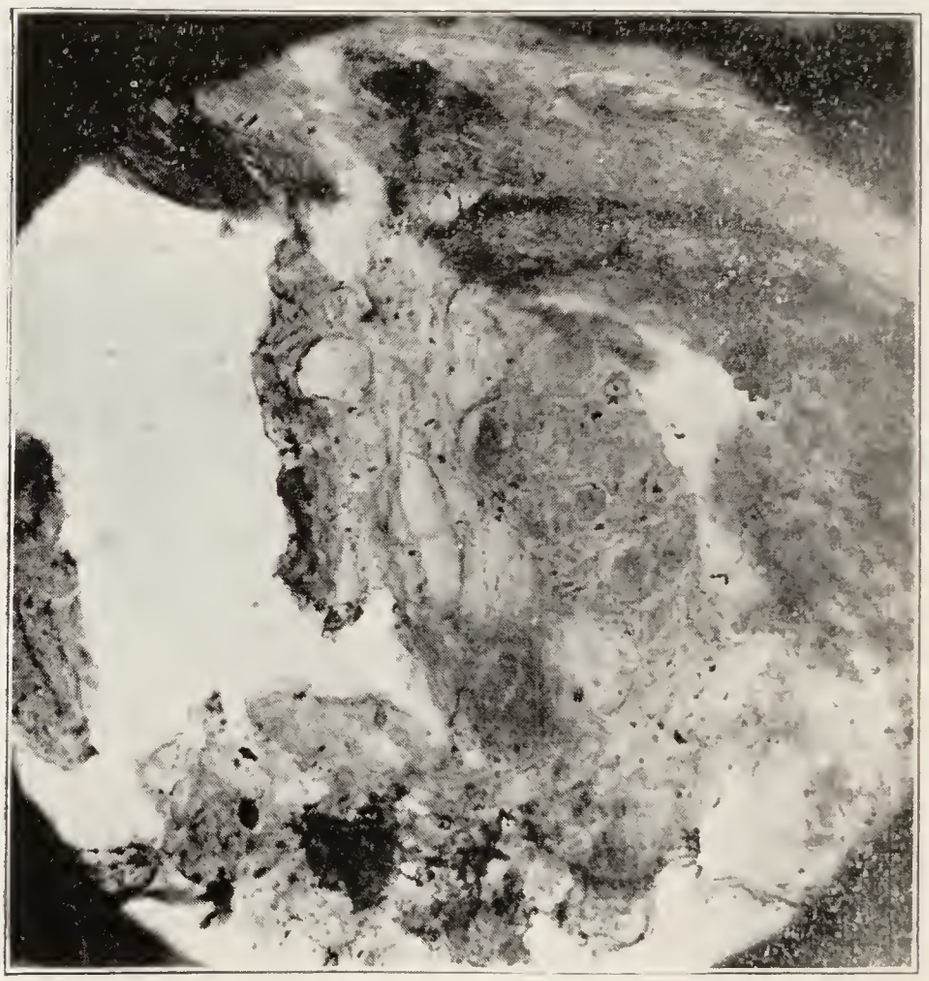
FIG. 4

Nerve ganglion with thickened interstitial tissue from the right coronary. The ganglion is in the midst of the atheromatous and decalcified vascular wall and in the middle coat. Occ. 4, obj. 1 in. (Swift's).

and neuralgic theories of cardiac pain appear to have been rather the coinage of their authors' brains than the result of anatomical investigation. As a matter of fact, the nerve trunks of the heart and the ganglia of the cardiac plexuses may be observed in those dying from angina pectoris to be, as a rule, normal for the age of those affected. Thus any interstitial thickening of the trunks which may be thought

to exist is seldom capable of being regarded as inflammatory and the only change observed in the cells of the ganglia is that of pigmentary degeneration, and a greater difficulty than in young and fresh material of staining the component parts of the cell. Such has been my own experience and it appears to be the rule, but there are important exceptions in nature to all that we, in our impatience, regard as "the rule." Indeed, in the fatal case of angina from

FIG. 5.

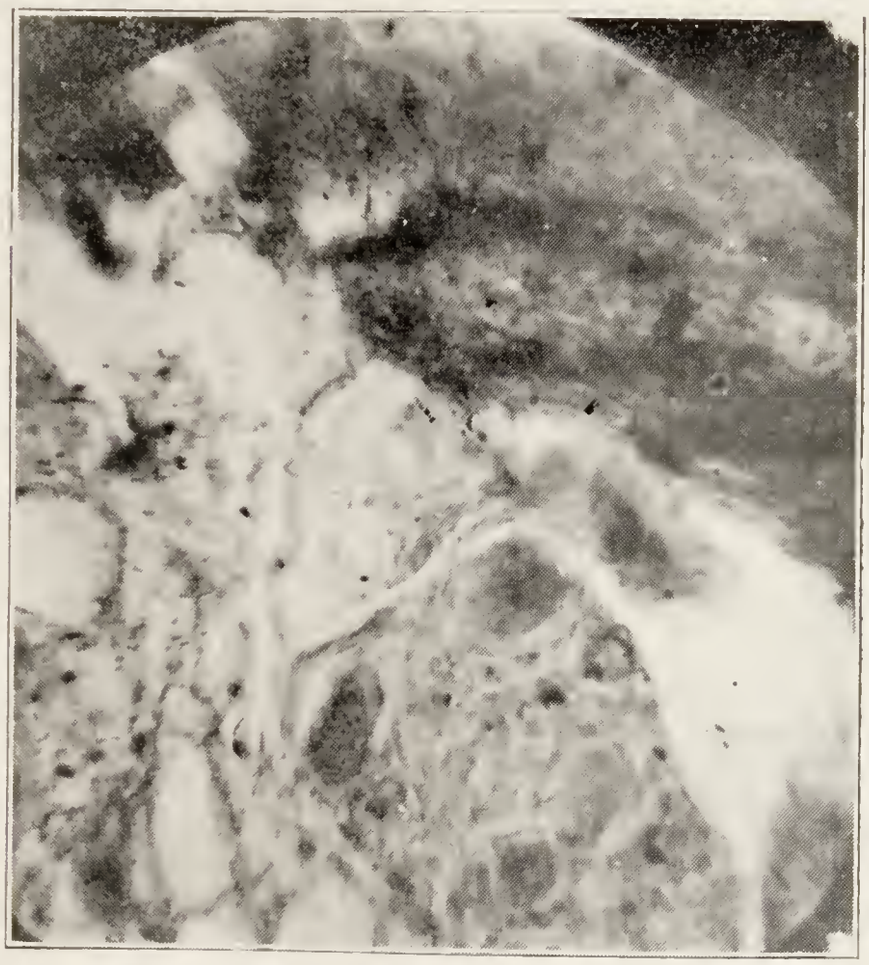


The same more magnified. Occ. 4, obj. $\frac{1}{6}$ (Swift's).

which I obtained the internal aneurysm to which I have already called your attention I met with a cluster of shrunken cells in an atheromatous patch flanked by calcareous deposit, which I am inclined to regard with some assurance of certainty as a nerve ganglion thickened by an inflammatory proliferation of its intercellular structure. The object appears rather too large from our preconceived notions for a possible ganglion in this situation, but the unexpected not infrequently happens in histology and after

careful examination I think that the view which regards this structure as nervous is correct. From a comparison of sections it appears to lie in the same portion of the circumference of the artery as that in which I found the aneurysm but not at quite the same level. These two pathological conditions could not have been far from one another. There is also in the immediate neighbourhood of the head of the aneurysm a transversely divided and thickened nerve which may possibly have some

FIG. 6.



The same, showing nucleus and nucleolus in the cell highest to the right. Occ. 4, obj. $\frac{1}{12}$. (Oil immersion.)

connexion with the ganglion I have mentioned. (*Vide* Fig. 7.) I have placed the specimen under a microscope for your inspection and thrown upon the screen excellent photo-micrographs of it executed by my friend, Mr. Frank Crosbie, to whose kindness and skill I am indebted for all the transparencies I have shown you. The following is a description of the specimen (Figs. 4, 5, and 6): in a transverse section of the right coronary artery of the case mentioned their lies an encapsuled cluster of cells, each of which has a clear round nucleus with a single nucleolus as

may be determined by careful focussing in a clear light. The cell body is of a brownish-red colour and has shrunk away to some extent from the walls of its capsule, if it originally quite reached these. The cells are separated from one another by a considerable thickness of intercellular connective tissue. A cluster of seven cells is sharply marked off from the surrounding textures by an encircling capsule.

FIG. 7.

Section of the aneurysm previously figured, but showing transverse section of a degenerated and thickened nerve-fibre above the head of the aneurysm in the middle coat of the vessel.

Near the lower end of the cluster and to the left there is a detached cell of the same character as the others, but within a more thickened capsule The cells, their capsules, and the intercellular tissue have a different colour from the surrounding textures. The latter on all sides of the cell cluster except to the right is altered intima stained blue by hæmatoxylin. The spaces in its (fenestræ) are empty and

in one place the space is open at both ends. To the right of the cell cluster there is a space free from texture except at two points where there are portions of an amorphous material stained blue. This vacant space probably marks the former site of a calcareous deposit which has been dissolved by the acid in which the preparation was placed prior to section and the blue patches necrotic atheroma. The general position of the cell group is in the greatly overgrown and degenerated inner coat and close to the muscular or middle coat. Internal to the well-marked line—the membrane of Henle which separates the media from the intima—and immediately next it there is a layer of material, granular in aspect, in which the circular course of fibres is not evident, and at places in which there are some transversely divided fibres and also small blood-vessels. Interspersed between the outer end of the cell group and this layer there is a narrow tongue of blue-stained atheromatous necrosis. The colour of the cell group, of its capsule, and of the intercellular tissues approximates most closely to that of the muscular layer and to that of the vessels and nerves lying external to the outer or fibrous coat of the artery. I have gone thus minutely into the particulars of this specimen in order that all may judge of the evidence for and against its neural nature. If the decision be that it is neural—and personally I have no doubt on this point—that fact would necessarily be an important one in its bearing upon a possible cause of angina, for although the peripheral ganglion itself was probably motor in function it nevertheless must have contained sensory elements.

With regard to the condition of the nervous system in angina pectoris outside the heart and the vessels in the immediate neighbourhood of the heart facts are still much lacking. Huchard refers to a form of angina attributed by Cuffer to the bulb becoming involved by the spread of an ascending neuritis of the pneumogastric nerve[15] and the lightning pains of locomotor ataxy probably due to inflammatory changes in the ganglion on the posterior root of the spinal nerves have at times been regarded as causal of the cardiac crises which occur in some of these cases. But as aortic lesions are likewise met with, frequently in the latter, such attacks may really be referable to a nearer cause than any change in the posterior root ganglia of the spinal cord. Of tissue changes in the higher nervous centres which might be construed as causal of angina pectoris we know nothing.

The most humble texture in the structures we are considering in relation to cardiac pain is the connective tissue. It is the mortar of the building and, though humble, as important as mortar is to the security of the whole. However strong and important the other elements may be the strength of the whole is dependent upon the

[15] Op. cit., p. 598.

strength and good quality of that vital cement of the organs. That its thickening under strain and as a consequence of the general stress of life should in a measure, and for a time, be conservative in character seems only reasonable, but the overgrowth of so humble a texture is but the prelude to decay and the introduction with such decay of the destructive processes of inflammation, the shrinking of its texture and the strangling by it in its vicious decrepitude of the important structures which it keeps together. As life advances, therefore, or in consequence of the abnormal senility precipitated by diseased action, a gradual strengthening of the connective tissue of the heart and vessels may be observed which soon begins to hamper the action of the organs it endeavours to uphold in their integrity. As regards the muscle of the heart and vessels, this responds to the call made upon it by increased growth—by hypertrophy—which we have seen to be a result of atheromatous thickening in the coronary artery and arises under the stimulus of an impediment to circulation in the heart, and which, later, as rigidity is increased and nutrition is interfered with, leads to degenerative changes in the essential muscle cells. This, especially if coupled with an invasion by fat cells in excess, rapidly degrades, as I have already noted at the commencement of these remarks, the normal character of the muscle. A moderate and perhaps temporarily beneficial cardio-sclerosis then passes into a chronic myocarditis, with interstitial cellulitis, obliterative endarteritis, atheromatous change, destruction of vessels, exposure of sensitive structures, painfully exercised function, and the death of the organism.

LECTURE II.

Delivered on June 23rd, 1902.

On the Clinical History of Cardiac Pain.

Gentlemen,—The classification of the varieties of an affection which is denoted by a term that has but the significance of a symptom must of necessity be a classification of symptoms. The terms "true" and "false" convey little meaning and the degrees of severity or fatality denoted by such words as "gravior" and "mitior" are not much more enlightening, while the use of such general terms as "vaso-motor," "arterial," or even "coronary," is but the indication of dissatisfaction with the indefiniteness of the terminology of the disease usually employed. In view of these facts and after an inquiry into the physical basis of the affection it seems desirable that we should attempt a classification, however provisional and transient it may prove, which endeavours, in the light of facts still too few in number, to give a local habitation and a name to phenomena which we are not yet in a position to explain with scientific precision. With these reservations it appears to me that we are in the meantime justified in discriminating pathologically between the modes of cardiac anguish on the lines indicated in the following table :—

- Cardiac anguish (angina pectoris).
  - I. With pain (Heberden's disease).
    - 1. Musculo-spasmodic.
    - 2. Coronary.
      - Aneursymal.
      - Occlusive.
    - 3. Aortic.
      - Aortitic.
      - Aneurysmal.
    - 4. Neuritic.
      - Intra-vascular.
      - Extra-vascular.
    - 5. Neuralgic.
      - Intrinsic.
      - Extrinsic.
    - 6. Endocardial (valvular).
      - Severe.
        - Aorto-coronary.
      - Mild.
        - Ventricular.
    - 7. Vaso-motor (? peripheral).
    - 8. Compound.
  - II. Without pain (angina sine dolore).
    - 1. Fear with syncopal signs.
    - 2. Fear without syncopal signs.
    - 3. Syncopal bradycardia.

Musculo-spasmodic angina.—"Angina pectoris, as far as I have comprehended its nature." writes Heberden,[1] "seems to be related to distension (*ad distentionem*), but not to inflammation." He then goes into several reasons for coming to this conclusion and the last of these is that "it affects some after the first sleep, as is frequently the case in diseases from distension." The word I have literally translated distension is evidently meant to convey the idea of spasm—spasm like cramp in the leg after sleep. M. Huchard, who in his excellent work bends all his ingenuity towards proving that the sole cause of angina is really a more or less sudden anæmia of the cardiac muscle due to atheroma of, or imperfect circulation in, the coronary arteries, places Heberden's notion among the many exploded theories which he enumerates.[2] Professor Clifford Allbutt appears to agree with him on this point.[3] Professor Osler, however, does not so definitely dismiss Heberden's view as untenable. In his "Lectures on Angina Pectoris and Allied States" he writes: "Pain, the special feature of the angina attack, is explained by the cramp theory. The most intense suffering which can be experienced is associated with muscular contractions of the tubular structures, as in intestinal, biliary, and renal colic, and in the contractions of the uterus in parturition. And, observe, that this agonising pain is in parts not endowed, so far as we know, with very acute sensibility. Theoretically, there is much in favour of the idea that in the most powerful muscular organ of the body, irregular cramp-like contractions, even if localised, might be accompanied by painful sensations which could attain the maximum intensity present in an angina attack" (p. 120). He, however, perceives that this theory cannot account for "frequently recurring attacks."

My line of argument on the present occasion commits me to the support of no single theory of angina pectoris. I have already suggested that the frequently occurring attacks associated with calcareous arteries may be due to a neuro-vascular condition, the chief element in which may be an aneurysm which has not yet eroded through the muscular coat of the vessel and gained a position of greater freedom and one less influenced by passing variations of intra-vascular blood pressure. I have shown you direct evidence of this, as I take it, in the intra-vascular aneurysm already referred to. But circumstances alter cases and such alteration demands and denotes a difference in the mechanism of the production of pain. That a whole heart could be in a condition of tonic spasm and yet the pulse proceed more or less altered is not to be thought of. On the other hand, a rhythmically contracting organ—and we have

[1] Commentarii, p. 312.
[2] Maladies du Cœur, &c.
[3] Lane Lectures, reprint, p. 115.

seen that this rhythmicality is an inherent property of the heart, apart alike from blood-supply and innervation—may, as it seems to me, be affected by a cramp in limited areas which crushes in its tonic grip the sensory nerve endings of the organ and, if unrelieved, is calculated to induce by way of the pneumogastric nerve a profound and, it may be, fatal inhibition, the visible sign of which is the flaccid diastolic heart found post mortem in those who die in the agony. This behaviour on the part of the cardiac muscle, while probably favoured by an insufficient coronary circulation in some cases, might, as it seems to me, in view of the inherent rhythmicality of cardiac muscle, arise from physico-chemical changes in the muscle itself, apart from the *quantity* of its blood-supply. For such a fatal attack appears to be possible from over-exertion in cases in which the blood-supply to the organ is little interfered with, in which atheroma, either of the aorta or of the coronaries, is not in an advanced degree and in which muscle fibres are in many portions fairly free from degenerative changes. As an example of cases capable of bearing such an interpretation I may relate the following.

On Nov. 10th, 1901, I was hastily summoned to a gentleman whom I had met in society but whom I had never previously seen professionally. He was 63 years of age and had some months before returned from the far East, where he had spent many years of his life and where he had comparatively recently married a native by whom he had two children. He had suffered, I was told, a good deal from his liver while abroad and about two years before his return to England he had experienced what would seem to have been a severe syncopal seizure. He was, however, pronounced sound after this illness and in September of last year he consulted a well-known physician in London who likewise pronounced him organically sound, as I learned from the patient's diary, but stated that he was suffering from an excess of "uric acid" and prescribed exercise and an antilithatic dietary. He accordingly used chamber gymnastics and cycled. I learned from his partner in business that he was an energetic and excitable man. He was short, rather stout, and bald, and what remained of his hair was grey. He was alert and active-looking for his age, a good billiard player and most careful liver, dieting precisely as he had been instructed and taking probably more exercise than had been enjoined. He regarded himself as perfectly sound and from his business arrangements would appear to have entertained the expectation of a prolonged existence. The day before I saw him was Lord Mayor's Day and he went with his young son to the show, stood in one place for two hours, afterwards visited St. Paul's Cathedral, and carried his child up and down the stairs of the Underground Railway. He retired to rest apparently quite well and slept well during the night. At five o'clock in the morning he had a severe attack of

pain in the chest which passed off and which after a time recurred. About 8 o'clock he sent for me. I saw him at 9 o'clock. He was quite comfortable when I reached him, but told me that the pain he had experienced was very severe, yet he did not seem unduly alarmed about it. Soon after I arrived he was seized with pain in the centre of his chest with radiation down his left arm to his hand. The attack was severe. He rolled round on his right side supporting himself on his elbow and closed his eyes with an expression of agony. His pulse was not quickened but during the pain it occasionally intermitted. Its palpability varied; it was at times larger and more easily felt and again smaller and less palpable. After the attack passed off the pulse was smaller and more rapid than during the persistence of pain. I gave him at once an ounce of brandy without water as it was the only stimulant available. The attack lasted about three minutes and then subsided and the patient declared himself to be free from pain. This complete subsidence of pain is a remarkable phenomenon in these cases and is probably due to the comparative insensibility of visceral sensory nerves except, as was remarked before, in circumstances of cumulative or excessive stimulation. The respiration was restrained during the agony but his breathing was not otherwise disturbed or difficult. After a time he had slight recurrences of pain and I gave him more brandy. These, too, passed off and he declared himself to feel better. Having prescribed trinitrin and enjoined his remaining strictly in bed, I left him for a short time apparently quite comfortable, to breakfast with a friend a few doors from the house of the patient. While at breakfast I was urgently summoned to him again and arrived without loss of time. I was informed that he had been feeling fairly comfortable and had asked for some tea and toast but again experienced a recurrence of pain and immediately thereafter began to breathe stertorously. When I reached him he was unconscious but occasionally groaned. His pulse was imperceptible and the heart sounds could not be heard, while his face was cold and clammy and tears flowed down his cheeks. I injected strychnine and morphia hypodermically, which had no effect, and used artificial respiration. His breathing, however, became irregular and slower and he died within 15 minutes of his seizure. I learned afterwards that two days prior to his death he had had some discomfort in his chest which he regarded as rheumatism and used some liniment for it but attached no importance to it. In view of subsequent events, however, it is possible, as the patient had been leading a very active life, that this may have been a prodromic symptom of the angina which slew him in what was practically his first attack. For the series of attacks on the day of his death constituted a more or less continuous status anginosus. I obtained permission to examine the heart after death. This is the case which manifested slight atheroma of the aorta, with a com-

paratively early stage of that change in the coronary arteries, fatty infiltration of the cardiac muscle, and fine fatty degeneration of the muscle fibres. I have already shown you sections from the case when dealing with the pathology of the condition and now show a lantern slide of the general appearance of the fat-laden heart and a preparation of the base of the organ and of the aorta, showing normally patent coronary orifices.

To consider the painful angina in such a case as due to defective circulation in coronary vessels which were widely patent and only moderately thickened in their inner coats and to ignore the invasion by fat and degeneration of the muscle itself, as a thorough-going adherent of the coronary vascular theory like M. Huchard would do, appears to me to be unreasonable. On the other hand, there was certainly nothing in the condition of the aorta to support Professor Clifford Allbutt's views as to the aortic origin of all angina and I showed you in the last lecture that the nerves in this case and the ganglia might be regarded as normal for the age of the patient. In these circumstances we are justified, I believe, in maintaining that in one variety of painful angina the muscular factor in spasm plays the leading part and that the simple and obvious interpretation given by Heberden of some of these cases is correct. That such, like most other cases, are compound will be argued later and then a subsidiary rôle may rationally be assigned to other factors in cardiac action.

I have also seen another patient die in the first attack, in which the pulse was full, slow, and soft during the agony. The patient was a gentleman, about 60 years of age, rather stout, of a florid complexion, and a temperate man of industrious habits, but rather a heavy smoker. In this case there was no post-mortem examination but I should clinically class him with the case I have just related. I have also seen angina in a similar case which threatened to be fatal pass off and not recur, although, of course, it may, for the patient still lives.

Aneurysmal coronary angina.—Since the day on which Edward Jenner, with that simple yet rare acumen which characterised the first vaccinator, found something gritty strike his knife at a necropsy on a case of sudden death and thought that a portion of the ceiling had fallen on the organ, but examining more closely discovered the first calcareous coronary artery in connexion with such cases, until now, that state of these vessels has been associated in the minds of physicians with the cause of angina pectoris. Jenner's friend John Hunter, to whose memory in some sense this college has been erected as a temple (for I remember his bust over the portico of the first building), died from angina and his heart, which was small and probably atrophied, contained the calcareous coronaries which Jenner was the first to detect in an indubitable case of angina. But many

instances have occurred in which these chalky channels have existed and yet the organ which has lodged them has at no time evinced the symptoms of angina. One cannot, therefore, use the presence of this condition alone as a factor in the more precise classification of angina. But some state in association with such vessels may well be distinctive of a type of that malady.

It would be hasty and unscientific to assume, because in a well marked case of the classical variety of angina pectoris a well-developed internal or masked aneurysm with surrounding inflammatory processes has been found, and moreover in close proximity to nerves, that such a condition must necessarily account for angina in all such cases. I make no such claim. In complex cases of the disorder, and perhaps most cases are complex, other conditions may be more directly causal; but I think we are justified in assuming that the case in which this condition has been found, and which I shall relate presently as typical of the clinical history of this variety of the disorder, gave evidence of no other condition which could be regarded as more directly causal of the cardiac pain than this aneurysm and the neighbouring innervation of the vessel. I have, therefore, in the meantime taken this striking feature in the case as the mark of at least one variety of the disease and have used the term "aneurysmal coronary angina." Should a closer examination of decalcified coronaries reveal the fact that such aneurysms are common in them without having provoked pain the term will have to be abandoned. If, however, this does not prove to be the case it appears to me that we have in such a circumstance a simple and sufficient reason why an aneurysm such as this one, fully developed, sub-muscular, and freely communicating with the lumen of the vessel, pulsating with every throb of the heart, and recording on the muscular coat of the artery variations in arterial pressure, should explain, at least in some cases, why one person may have calcareous coronaries without angina and why another, with apparently the same condition of these vessels, should know all the agony of breast pang. What other circumstances in the case I am about to relate could have more directly caused angina? The vessels were much occluded but the cardiac muscle was well preserved, as I have already demonstrated. We have also noted the excessive freedom of coronary anastomosis and in this case the right coronary artery had two small orifices, one of which may have been in connexion with the third or supplementary vessel which sometimes exists and is known as the artery of Vieussens. The tension of the patient's pulse was somewhat raised, as will be stated, but the response of his heart's action to the pain was regular, quick, and as normal as that of any healthy heart would be under the emotion inseparable from such distress. The organ as a whole was neither hypertrophied nor atrophied. The

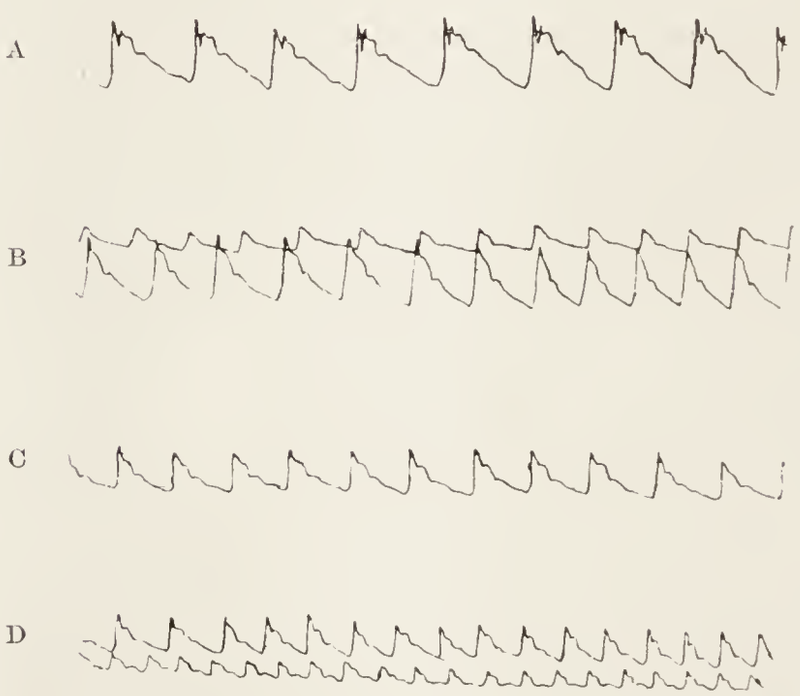
atheroma of the aorta apart from that of the coronary vessels was moderate in degree. The valvular apparatus of the heart was competent and unobstructed. It is true that a structure, probably ganglionic and inflamed, was found in the right coronary artery, but it could only have been recurrent fibres passing through the ganglion, not the ganglion itself, which caused the pain if the nerves were involved, for we at present believe that such peripheral gangiia have motor, not sensory, functions. The aneurysm, then, would seem to have been the efficient cause of pain in this case, the typical clinical history of which was as follows.[4]

The patient, a man, aged 53 years, a gilder, came under my care at the Great Northern Central Hospital on July 25th, 1894. He complained of breathlessness with attacks of pain in the chest which passed down the left arm to the fingers and up the left side of the head. He had suffered thus for more than seven years. He had never had rheumatic fever but had, during the 10 years previous to my seeing him, suffered from gout in the great toe on four occasions. When he first came under my notice nought amiss was detected in his heart beyond increased impulse. His pulse-rate was 60 and its tension was raised. Under the use of trinitrin and a mercurial pill the attacks became less frequent and the patient ceased to attend the hospital in August, 1894. On Nov. 21st of the same year he again presented himself, stating that he had been ill for ten weeks with what he called "rheumatic gout," an attack which would, no doubt, have been more correctly described without employing the qualifying adjective. He was rather under medium height, well-built, thin, with a dark complexion, grey beard, and bearing a feeble and suffering expression. On examination his tongue was furred, his appetite was bad, and his bowels were costive. His pulse-rate was from 66 to 72 and its tension was slightly increased. The heart sounds were clear, the apex beat was diffused, and there was systolic and diastolic pulsation in the epigastrium. The lung sounds were normal. His urine was sufficient in quantity and contained neither albumin nor sugar. The arcus senilis was present in both eyes. He still complained of breast pang and the following particulars as to its character, situation, and the circumstances in which it occurred were elicited on this occasion. The pain commenced about the level of the fourth rib on the left side, passed up to the sternal notch, and gave rise to a suffocative feeling; it was then felt in the left shoulder and down the left arm, being felt in the four fingers of that hand, never in the thumb and most acutely in the ring and little fingers. The pain was also stated to shoot up the nape of the neck and into the head. It was severe, lasting sometimes ten

[4] Particulars of this case were first published in Treatment on Oct. 28th, 1897.

minutes, sometimes for half an hour. The patient could not move when the attack came on, as every step appeared to make it worse. He was compelled to stand up and could not lie or even sit down. It caused him to breathe deeply but not quickly. It induced involuntary micturition. When gas escaped by the œsophagus he experienced relief. This occurred in a minute or two after the commencement of the attacks. He stated that the heart beat "very fast indeed" during the attack and as pain passed off it became quieter. The attacks usually occurred after some exertion but on two occasions had wakened him out of sleep. On

FIG. 8.



A Tracing of right radial pulse; free from pain and without trinitrin; Nov. 28th, 1894. B The same; free from pain and under trinitrin; upper, full effect of drug; lower, effect subsiding; Dec. 5th, 1894. C The same; pain just passed off; no drug used; Jan. 16th, 1895. D The same; lower, during attack of pain; upper, pain subsiding under trinitrin.

awaking thus in pain he observed that his heart was beating quickly. He felt at times during the attacks as though he would not recover. They caused him to feel cold. He did not, however, perspire after or during the attacks. He had found during his first attendance at the hospital and while taking trinitrin that the attacks were of short duration and that he had been much relieved thereby. Five-minim doses of liquor trinitrinæ were prescribed, the mercurial pill was repeated, and he was asked to take a mixture containing nux vomica, chloride of ammonium, and bicarbonate of sodium. Notwithstanding the temporarily beneficial action of the

trinitrin the attacks of breast pang continued and became more frequent. To ascertain the sphygmographic character of the patient's pulse, as also the effect upon it of trinitrin, the tracings A, B, and C (Fig. 8) were taken on Nov. 28th and Dec. 5th, 1894. The trinitrin was administered in the absence of angina. On Dec. 12th a soft systolic mitral bruit was noted for the first time, and in view of the increased dilatation of the left ventricle which this sign indicated a mixture containing tincture of digitalis and liquor strychninæ was prescribed, and on Jan. 2nd, 1895, the patient felt better though the attacks were still frequent and the apex bruit was not audible. On the 16th it was noted that the pain tended to spread into the *right* arm. While seated in the waiting-room of the hospital the patient had occasional attacks of angina and on the 16th while under examination by me he had a moderately severe attack. The pulse-rate rose to 114 and fell to 96 when pain passed off. The sphygmogram C (Fig. 8) was taken immediately after relief, no drug having been given. After this date the mitral systolic bruit was usually present and the attacks of angina were frequent and of variable duration—so frequent and so variable in severity that some who saw the case believed that the patient was dyspeptic rather than suffering from true angina. Latterly even the trinitrin, which he regarded as a friend in need, ceased to relieve him to the same extent as previously. Finally, on June 29th, 1895, at 5 o'clock in the afternoon, he was seized with pain in the chest in his own house. He said that he felt as though his heart would burst, remarked that he felt faint, and fell down on his knees. Just previously to this he had taken the trinitrin, said that the drops would be of no use to him this time, and expressed the hope that "the Almighty would take him." He spoke no more and died without a struggle at 5.30—that is to say, in about 25 minutes after he was seized with breast pang. These particulars I ascertained from those who were present at his death.

External and evident aneurysm of the coronary arteries is not unknown but has been rarely reported. In the Transactions of the Pathological Society of London [5] Dr. T. B. Peacock relates a case the previous history of which was unknown but in which the patient had an attack of angina on the day preceding death. It was not, however, the actual cause of death which seems to have been due to a rheumatic attack with sero-purulent pericarditis. In this case there was an aneurysm of the left coronary artery as large as a pigeon's egg which was buried in the left ventricle at the base of the heart. Peste [6] reported a case which is quoted both by Peacock [7] and by Huchard [8] in which the patient, a man

[5] Vol. i., p. 227.
[6] Archives de Médecine, 1843.
[7] Loc. cit.
[8] Op. cit., p. 840

aged 77 years, died from the rupture of an aneurysm of the size of a hazel-nut in an ossified coronary artery. Huchard likewise mentions a case published in an inaugural thesis by Hofmann in 1886, in which a woman, aged 33 years, who suffered from asthma and angina pectoris, exhibited after death, with other changes, aortic valvular disease and an aneurysm of the right coronary artery. The conditions indicate this case as having been syphilitic. In the Transactions of the Pathological Society[9] Mr. J. Jackson Clarke relates the case of a child who exhibited numerous aneurysms on the coronary arteries which it is suggested were probably either specific or micrococcic. The child had acute endocarditis.

Coronary occlusive angina.—Some who are averse to the acknowledgment of a musculo-spasmodic angina of the cardiac muscle itself do not hesitate to admit the feasibility of a theory which rests upon an intermittent spasmodic closure of the coronary vessels, having in its train an ischæmia of the cardiac muscle which eventuates in the angina. With this claudicatory theory I am not at present concerned. In the last lecture I pointed out how absolutely hypothetical the conception of such a mode of angina at present is. By coronary occlusive angina I mean an angina the result of atheromatous occlusion of the coronary arteries. We have seen how as life advances there is a thickening of the internal coat, which, if in a measure protective at its outset, passes in many cases into a destructive phase, leaving in its train impediment to the circulation, with or without additional lesions, involving a solution in continuity of the coats of the vessels. With one phase of this vascular destruction—namely, aneurysm of the coronary artery—we have already dealt at some length. On occlusive coronaritis or atheroma I wish in this place to say a few words. Given satisfactory proof of the apparent soundness of the cardiac muscle, of the nervous apparatus governing the sensibility and motions of the heart and of the character of the blood itself, and given then a considerable impediment to the flow of blood into both coronary arteries, I am prepared to admit that the chief factor in the production of angina in some cases may be a condition of difficult circulation in the nutrient arteries of the heart. But this is a very different position from that taken by those who, on the detection of a certain amount of atheroma in the coronaries of those who die from angina pectoris, assume without more ado that this state of the coronaries is chiefly responsible for the syndrome of Heberden's disease. It is notorious that the exclusion of the other possible factors in the disorder is in many cases not even attempted, and that even when it is attempted it is done without the exhaustive investigation which alone carries

[9] Vol. xlvii., p. 24.

weight or brings conviction to the mind. While, therefore, coronary occlusive angina may be accepted as a variety of that affection, we cannot too soon emancipate ourselves from the thraldom of too narrow a view of the causation of angina, however influential the nominal support given to such a theory. "Facts," alone, "are chiels that winna ding, And daurna be disputed," and they are only to be found by looking not for them, which is dangerous, but for "more light."

Aortitic angina.—I have postponed until now the consideration of acute aortitis because one of the best descriptions of the disease in association with angina with which I am acquainted is from the pen of M. Huchard, with whose argument founded upon it I am unable to agree.

Adrien G., 32 years of age, a stoker, was admitted into the Hôpital Tenon under the care of Huchard on Feb. 6th, 1883. A drunkard, he had contracted syphilis in 1872. For a month he had complained of vague pains in the chest coming on during work, accompanied by radiations into the left arm, the elbow, and the two last fingers of the left hand. The pains come on suddenly and while they last he has to leave off work. The lungs and the heart are perfectly healthy; neither at the apex of the heart, nor at the base in the aortic region, can abnormal signs be discovered. The urine is clear, sufficient, and without albumin. On Feb. 11th at the morning visit he complained of uneasiness in the præcordial region, with slight pain in the left arm. The patient was able, however, to leave his bed and the day passed comfortably enough. At nine o'clock in the evening he awoke suddenly and complained of a violent agony—an atrocious pain with a sense of suffocation in the præcordial region which caused him to writhe on his bed. The face became cyanosed and the patient constantly placed his hands over the lower part of his chest, as if to remove an insupportable weight. This painful crisis, accompanied by anguish, lasted with various recurrences till half past 11 o'clock; at no time during this final attack did the patient complain of pain in the arms. He died in a minute.

Necropsy.—The lungs are much congested, allowing very dark blood to escape on section. Over the course of the aorta from its origin to the pillars of the diaphragm an enormous injection reveals itself as an extremely well-marked vascular network. In the sheath of the artery at its posterior part, at the level of the periaortic pericardium, there are four ecchymoses, situated one at the origin of the brachiocephalic trunk and the left carotid and three others about two centimetres from one another. They are each of about the size of a lentil. On dissecting the aorta there is well-marked congestion of the surrounding structures, but the congestion does not reach the pneumogastric nerves. At the final portion of the arch of the aorta where it becomes vertical there is in its interior a large patch of aortitis three and a half centimetres long, following the course of the vessel, and almost two centimetres broad. This patch is situated to the left and rather posteriorly in the aorta. It makes a marked elevation on the interior of the vessel and is not at all calcareous. It has a gelatino-fibrous consistency, pale grey colour, and irregular outline and surface. A fresh section examined microscopically showed a very abundant proliferation of connective tissue in the internal coat and a well-marked thickening of the middle coat; the outer coat is slightly thickened and the connective tissue there is more abundant than normal. In the patch of aortitis there is neither fatty nor calcareous degeneration. On continuing to open the vessel in the direction of the left ventricle we find another patch of inflammation just where the left carotid arises. The calibre of this artery is also much diminished and is scarcely a fourth of its normal size. This patch goes quite round the carotid, but does not project more than

half a centimetre into its interior. It, also, is fibrous, not calcareous. Still lower we observe at the root of the aorta, over the whole expanse of the vessel, at a height of three centimetres and one and a half centimetres above the free edge of the sigmoid valves, a swollen surface, pale grey in colour, with a sinuous outline, rather hard to touch, but not calcareous. It would seem, then, to have been a matter of comparatively recent aortitis. The cardiac muscle was pale and had a little surplus fat. There were no inflammatory lesions on the mitral and tricuspid valves. The aortic valves were competent and without a trace of inflammation. The cardiac muscle examined microscopically was found healthy. The other organs are much congested; the kidneys, the liver, the spleen, the pia mater, the brain, the bulb; they showed no other change. The cardiac plexus was not examined microscopically, but by the naked eye it was impossible to detect the least trace of periaortic hyperæmia. The ecchymoses which were found in the front of the aorta were nothing more than the results of the suffocative conditions which terminated the attack; they could in no way be regarded as a cause of the angina. The inflammation of the aorta has produced a considerable diminution in the size of the coronary arteries. These arteries themselves have an important peculiarity; thus, we find only one coronary arising at the level of the free edge of the sigmoid valves; its orifice is so diminished under the influence of the endarteritic inflammation that one can scarcely pass the point of a very fine probe through it. Immediately thereafter the calibre enlarges and resumes its normal diameter.

The report of this case, contributed by M. Huchard and M. Pennell, first appeared in the *Revue de Médecine* in 1883 and is among those so industriously collected and published by M. Huchard in his well-known work, to which I have already had occasion to refer (p. 824). I offer no apology for having translated this fragment literally and transcribed it bodily. It is the work of a master alike of language and of clinical observation. It is also the work, if I may say so, of a special pleader in pathology. The inflammation did not touch the pneumogastric, the cardiac plexus was to the naked eye free from inflammation, but the blood-supply to the organ was encroached upon in a very remarkable manner. Yet, the cardiac muscle, though pale, was normal, and the valvular apparatus of the heart was sound. "*La théorie artérielle, coronarienne*" holds good even here! Now, so long as blood gets into the coronary system at all the absolute freedom of anastomosis in that system seems to render it a matter of little moment whether a man have one or three coronaries and whether his arterial orifices gape or are contracted. Localised portions of the myocardium may become fibrotic or degenerate from being robbed of blood, but this occurs only when the larger vessels are absolutely closed or smaller branches are occluded by peripheral endarteritis which has nothing to do with atheroma. For, as Coats and Auld have shown, these processes play opposite parts, atheroma affecting the larger, endarteritis in its obliterative phase, most characteristically, the smaller vessels. In M. Huchard's case the cardiac muscle was healthy and we may therefore take it that its blood-supply was not materially interfered with. But no one has more graphically or better described the potential sensibility resident in arteries than M. Huchard and in the widespread and superbly de-

lineated acute aortitis in this case it seems to me that we have quite a sufficient explanation of the breast pang of this patient without the importation of any more obscure theory. This case, then, I would submit, was no evidence of the relation of the coronary circulation to angina pectoris but of the anginal pain associated with an acute aortitis, a variety of the disorder which may be suitably described as aortitic angina. Such a case offers every support to the views of Professor Clifford Allbutt, who has eloquently enunciated the aortitic theory of angina. "Many years ago," he writes, "in the days of my studentship at St. George's Hospital, a case came under my notice which I see as vividly as if the patient were still before me. A man of some 30 or 34 years, of vigorous frame and apparently of vigorous constitution, lay propped up in bed in extreme agony. He complained, when he could whisper to us, of intense retro-sternal pain, never absent, indeed, but returning upon him in paroxysms. The pain radiated about the shoulder or shoulders ; whether it extended down the arm I cannot remember. The respiration was restrained in dread. There were no physical signs to betray the presence of the disease within. What I vividly recollect, as if burnt into my mind, is the aspect of the man, bound on the rack in the presence of death, and yet, for the agony at the centre of his being, unable to cry out. Consultations were held but to little purpose, save to certify that the case, if one of angina pectoris, was a strange one, because of its continuous if still paroxysmal character, and because of the fever with it. Bence Jones, whom no man exceeded in brilliancy and rapidity of diagnosis, declared for acute aortitis ; the patient died suddenly soon afterwards and the necropsy justified Bence Jones's opinion. On the inner surface of the ascending aorta were groups of grey, semi-translucent patches disfiguring the walls of the slack and dilated vessel ; and—let this be carefully noted—no other cause of death was discovered. The heart and coronary arteries were healthy."[10] After discussing acute aortitis he proceeds to describe a case of "stenocardia" induced by such exercise as walking up a hill, and comes to the conclusion that the pain in such "*and in* ALL *such cases is not cardiac but aortic.*"[11] That the clinical picture which Professor Allbutt has so eloquently word-painted is associated with paroxysms of pain which may justly be included in the category of anginæ pectoris cannot for a moment be doubted, and that he is fully justified in ascribing the distress to the local inflammation appears to be incontestable. But does such a fact, in view of the pathological bases of angina into which we have examined, justify so sweeping a generalisation as that which assumes that the pain characteristic of Heberden's disease cannot be originated elsewhere, in

[10] Lane Lectures, Reprint, p. 119.
[11] Ibid., p. 124.

muscle, or vessel, or nerve? I would respectfully assert that it does not, but that muscular spasm, aneurysmal pressure, and local neuritis, as well as other states to which we have still to refer, may cause pain which is certainly pectoral and retro-sternal, but neither aortic nor aortitic.

Aortic aneurysmal angina.—It is related of a Dutch boy that perceiving a leak in some portion of the dyke which has turned a waste of waters into a rich and thickly populated land, the Hollow-land, or Holland, he placed his little hand over it, gave the alarm, and held the ocean at bay until the defect had been remedied and the population saved. The narrative is probably true, for it is scientifically explicable. The pressure of fluid is proportionate to the surface it presses upon, no matter what its actual volume. We are not, therefore, surprised when we find the heart and coronary system little affected by the blood pressure even of large aneurysms in the aorta. What *does* frequently occasion us surprise is that patients should carry with them, sometimes for a lengthened period, considerable aneurysms of the aorta, with all their secondary vascular manifestations in impeded venous circulation, without evincing great discomfort and sometimes having no pain. But this is not by any means always so and there are probably few cases of aneurysm of the aorta which have not, at one time or another during their growth and existence, caused some pain. At times this pain is great and not to be distinguished, apart from local considerations, from angina pectoris due to one or other of the causes we have already considered. "Many authors from Morgagni downwards," writes Sir William Gairdner in his memorable essay,[12] "have recorded cases of thoracic aneurysm, having in a more or less perfectly developed form the characteristic symptoms of angina pectoris, and we have already alluded to M. Trousseau as confirming by his large and carefully-watched experience the view that such cases very closely resemble, and may, in fact, for a lengthened period and after careful examination, be indistinguishable from what he regards as the truly idiopathic forms of angina. The author of this article," he further states, "is able from personal experience to say that no organic disease has appeared to him more frequently to assume the symptomatic characters of angina than aneurysm, and he is also prepared to state as the general result of inquiries pursued over many years, and particularly directed to this subject. that even small aneurysms arising very near the heart, and especially such as project into the pericardium or compress in any degree the base of the heart itself, are much more apt to give rise to angina-like symptoms than much larger tumours in more remote positions." This important statement,

[12] Reynolds's System of Medicine, vol. iv., p. 544.

embodying the experience of one who by nature and opportunity has had every qualification for sound observation, justifies the classification of an important variety of angina as arising in connexion with aneurysm of the aorta. It is an important fact, also, that those aneurysms which evinced this symptom on the whole most markedly were *small* aneurysms, aneurysms which could not, to the same extent as larger tumours, have penetrated the muscular coat of the vessel and paralysed its grip on the throat of the sac. Knowing as we do the comparative insensibility of the viscera including the heart, and bearing in mind the fact that considerable pressure may be exerted on that organ without causing pain, it appears more probable that the anginiform symptoms in connexion with such aneurysms are due less to their pressure upon the heart than to the neuritic and lacerative processes taking place in the aneurysms themselves.

Intra-vascular neuritic angina.—M. Huchard,[13] having at heart the interests of his client coronary angina, lifts up his voice against the confusion of that variety with any neuralgic or neuritic pretender to the title of angina pectoris. With this attitude I am in no way concerned to quarrel, if the distinguished advocate will limit himself to the defence of his angina *as a variety*. But he will accept no such limited rôle. After demonstrating how even peripheral nerves will degenerate if robbed of their blood-supply and coming to the conclusion that the nervous accidents possible in the course of his angina are but accidents, neuralgic or neuritic, he presses the lesson home and exclaims : "There are not several anginæ pectoris, but only one—coronary angina" (p. 652). I admire the eloquence and ingenuity of the advocate ; I am not convinced by his argument. I have already shown you in dealing with the pathology of the subject, and buried in the wall of the right coronary artery of a patient who died in angina and after long suffering from angina, not only an aneurysm, but also an inflamed and thickened nerve ganglion. I do not say that this was the sole cause of the angina and of the vascular disturbances which follow pain in organs under the sway of emotion, but I defy either M. Huchard or anyone else to say that it was not at least as likely to induce these phenomena at times as any condition of the cardiac muscle, healthy to all appearance, notwithstanding a greatly hampered coronary circulation. That circulatory impediment may in a certain proportion of cases play the major rôle in angina pectoris I have already admitted. That it does so in all I deny. It is the more remarkable that M. Huchard should so inexorably limit himself to one explanation of angina because he has evidently carefully examined the condition of the coronary circulation and admits in one

[13] Op. cit., p. 645 et seq.

places a free anastomosis of the vessels but in another appears to agree with Hyrtl who denied this. He explains the absence of angina in some cases in which the arteries are calcareous and yet the muscle healthy, by maintaining that atheroma of this type may serve to maintain the patency of the vessels and that a supplementary artery may come to the aid of the threatened muscle. But in the case I have related the muscle was healthy, the vessels were much obstructed by a narrowing of their calibres, and there certainly was a supplementary artery of Vieussens, or fat artery, arising close to the right coronary. The case nevertheless had "true angina" and died in an attack, but the wall of the coronary artery contained both an aneurysm and an inflamed nerve ganglion. Therefore, I think we are justified in maintaining, contrary to the conclusion at which M. Huchard has arrived, that there is not only one angina pectoris but that there are several and that intra-vascular neuritic angina is one of these. Before M. Huchard can establish his theory, therefore, much water must flow below the bridges—many coronary arteries, calcified, atheromatous, and healthy, will have to be examined minutely, by many sections and in a considerable portion of their extent. Why, we do not even know what the anatomy of the innervation of the coronary arteries is. The results of the Golgi method, which I have myself used to elucidate this point, I regard now as altogether misleading in many instances.

Extra-vascular neuritic angina.—I have already stated that the extra-vascular nervous structures when they have been carefully examined in fatal cases of angina have frequently been found healthy, and this is in all probability true in some cases of the intra-vascular nerves also, but in a certain number of cases, as I have mentioned, the extra-vascular nerves are admittedly involved. In these we have seen that the affection of the cardiac plexus appears to have been secondary—a consequence of the extension of vascular inflammatory processes to the nervous elements in their vicinity. This was so in Lancereaux's case. In such cases the inflamed plexus may indeed be regarded as contributing to the angina manifested, but it is only an extra-vascular neuritic element in the case. In being so, however, this condition is not peculiar, for we shall learn that in the majority of cases the underlying physical basis of angina is complex. Most anginæ are probably compound, with in some cases a preponderant leaning towards one or other of the varieties which have been described. We are, however, but on the threshold of our knowledge of the rôle of the nervous system in angina and many more systematic and accurate investigations into the extra-vascular nervous system in such cases must be undertaken before we can speak with any authority upon this particular point. In "tabetics," using the word not as Heberden did when he classed tabetics with peri-

pneumonics,[14] but in the modern sense as applied to those having inflammatory changes in the ganglion on the posterior root of the spinal nerves and in the columns of Goll and Burdach, we find that the lightning pains experienced in the lower portions of the body have at times their homologues in the region of the thorax. While we have to be on our guard against confusing intercostal manifestations of this kind with pain in the nerve tracts passing from the spinal cord to the heart, there seems no sufficient reason to question the occasional occurrence of such. It is true that in some cases in which this condition (angina) has been reported the patient has also had aortic valvular disease and that both the nervous and vascular lesions have been attributed to syphilis. But the angina has, as a rule, been explained solely by reference to the aortic lesion and when the latter exists that conclusion is probably the most rational. But all tabetics have not aortic valvular disease and when angina of lightning-pain character arises in these it is quite possible that the source of the affection may be extra-vascular and neuritic—the peripheral and visceral expression of a central nervous lesion. Indeed, the radiation of cardiac pain outwards is in itself an argument in favour of the possibility of a projection of the irritation of the sensory roots of the spinal nerves inwards. Such a visceral projection of central stimulation might also follow the course of the pneumogastric tract, but as we have less anatomical evidence of this than we have even of protection from the centres of the sympathetic stream we cannot with any benefit enter into its further consideration at present. In the higher centres of the brain we have no physical pathological facts to justify our attributing angina pectoris to a central lesion, but in the introduction to these lectures the influence of the emotions on the action of all the viscera, and especially upon that of the heart, was pointed out, and Heberden recognised that excitement favoured the onset of attacks of angina (*perturbatione animi augitur*). The central influence, however, in such cases but stirs into activity the local factors in the disease elsewhere.

Neuralgic angina.—The use of this term raises the question of the propriety or otherwise of employing such an expression as "pseudo-angina." What is true angina? Contrary to the aim of some who have spoken and written upon the subject I have deliberately avoided referring the well-known clinical features of the affection to only one category of physical conditions. Pain and its consequences, when connected with a particular abnormal organic state, may bear a close resemblance to pain and its results when these are associated with another abnormal state—that is, the consequences have a unity which the causes have not. If

[14] Op. cit., p. 308.

angina pectoris be one it is also divisible ; but if there be real pain and the consequences of such pain are manifested in a typical manner by a series of recognisable phenomena, why regard it as spurious because when associated with a certain condition it is less fatal than when associated with another ? As I maintained in a paper on the blood pressure in angina pectoris, published in the Edinburgh Hospital Reports,[15] "A case of 'true angina' is one in which there is no doubt about the angina, and there is no mistake about the reality of breast pang in many so-called functional cases. ..... The idea of spuriousness is only permissible in so far as angina is not associated with demonstrable lesion, and because the tendency to it in many cases yields to judicious treatment or wears itself out." Professor Osler quotes these passages with approval in his instructive monograph on angina pectoris and adds (p. 87), "Herein lies the essence of the whole matter—the symptoms on the one hand indicate the existence of a grave organic, usually incurable malady, and on the other a condition very distressing, it is true, but rarely serious and usually curable. The advantages of thus recognising a functional group far outweigh any theoretical objections, and in a series of cases the forms are, with few exceptions, fairly well-defined." Now, actual *neuritis* is generally associated in angina with grave organic disease of the structures innervated, and it therefore appears to me to be preferable to separate these from cases in which no organic disorder is discoverable, and pain and its immediate effects are the chief phenomena. Long usage permits our calling such cases "*neuralgic* angina," which is perhaps more definite than, and preferable to, such terms as "false" or "pseudo-angina." Far as the nervous endowment of the heart and its vicinity still is from thorough elucidation, much progress has been made in unravelling this obscure subject. We know the mode of ultimate distribution to the cardiac muscle, we know somewhat the innervation of the blood-vessels of the heart, Thoma believes he has demonstrated Pacinian bodies in the vascular wall, the main nerve trunks have been known of old, and, as was shown in the first lecture, the sources of the visceral nerve-supply have in great measure been successfully traced ; why, then, hesitate to recognise a possible neuralgia of the intrinsic and extrinsic nervous mechanism of the heart ?

[15] Vol. iv., pp. 246–265.

LECTURE III.

Delivered on June 30th.

On the Clinical History of Cardiac Pain (*continued*).

Gentlemen,—The justification for the use of the term *endocardial angina* is the fact that whatever collateral consequences there may be of valvular disease of the heart, such as atheroma of the aorta or of the coronary arteries, it is indubitable that cases are met with in which the frequency and severity of attacks of angina are proportionate to the degree of non-compensation manifested by the organ. Thus there may be a storm of angina in aortic valvular disease of the heart during such a period of non-compensation which practically subsides when the heart has again acquired the power to establish a balance in the circulation. In these as in many other cases the physical basis of the disorder may be complex, but the element of non-compensation being the key to the situation, it is a legitimate inference that intra-cardiac pressure may be one of the factors in precipitating the attack of angina. Whatever consequence of the non-compensation may be selected as most suitable for rearing upon it a theory of the anginous attacks the central fact remains—non-compensation.

That a disturbance of the coronary circulation is not absolutely essential to the production of the cardiac pain and its brachial radiation I think I shall be able to prove to your satisfaction by relating some particulars of a very rare case which came under my care many years ago and an account of which I published at the time. Sir (then Dr.) T. Lauder Brunton in the *Practitioner* for 1891 developed the theory of cardiac distension as a cause of angina pectoris and that this may be a factor in the production of some degree of cardiac pain in cases such as we are at present considering appears very probable. Professor Osler,[1] however, pertinently inquires, "Why, if extreme dilatation is a cause, does it not occur more often? There must surely be some additional factor or attacks would be of everyday occurrence." The majority of cases of cardiac pain producing the syndrome of angina pectoris in valvular disease of the heart are cases of aortic valvular disease, and of the latter the majority are mainly regurgitant in character. Angina with endocarditic mitral disease is rare. In aortic valvular disease, and especially in its regurgitant variety, we

[1] Op. cit., p. 122.

usually have a powerful ventricle throwing blood suddenly into the aorta and as suddenly, of course, into the coronary vessels. The effect of the force of this impulse upon the interior of the coronaries may be broken if there be atheromatous narrowing of their orifices, but if the blood find quick and distensive entrance into these vessels it is not difficult to conceive in view of the facts I have already related in connexion with the innervation of the coronaries that the incentive to pain may be here in such cases. But I have met with anginal attacks, as I have stated, in a case of well-marked disease of the valves at the orifice of the pulmonary artery.[2] The cusps in this case were much distorted and covered with cauliflower excrescences and from their size and impact against the wall of the artery had provoked inflammation there. There were also scattered vegetations on the tricuspid valve and in the conus arteriosus. The case was one of long standing and occurred in a young man, 21 years of age. His cardiac pain radiated not to the left but to the right and was characteristic of distension and was not observed by me to be associated with the extreme agony and vaso-motor phenomena which we shall have to consider presently, although the patient stated that the pain was at times severe. There was, of course, in this case no coronary arterial factor to complicate the etiology of the pain. We may conclude, therefore, that a purely local cause such as distension of a chamber may have a certain but not a very powerful influence in calling into play the more immediate factors in the production of cardiac pain—namely, painful stimulation of the cardiac nerves, be it through stretching or through muscular cramp. The severer cases of endocardial angina are, as I have said, associated with aortic valvular disease. What are the central and consecutive phenomena in such cases? The following case, some particulars of which I shall relate, was published by me in the Edinburgh Hospital Reports[3] in my article on Blood Pressure in Angina Pectoris. It was that of a man, 32 years of age, who had never to his knowledge had rheumatic fever but who exhibited the full clinical picture of aortic regurgitation and in whom probably rheumatism, as so often happens in early life, had been overlooked. He came under my care in May, 1894, at the Great Northern Central Hospital. In December, 1893, he began to suffer from attacks of pain in the chest, severe in degree, and in the first instance passing up to his left shoulder and down his left arm. As the attacks became more severe pain radiated even down his right arm and affected his legs and body generally. He also noticed that when pain passed off a tenderness remained in the præcordia to the left of the sternum. Brandy at one time relieved these attacks but later it

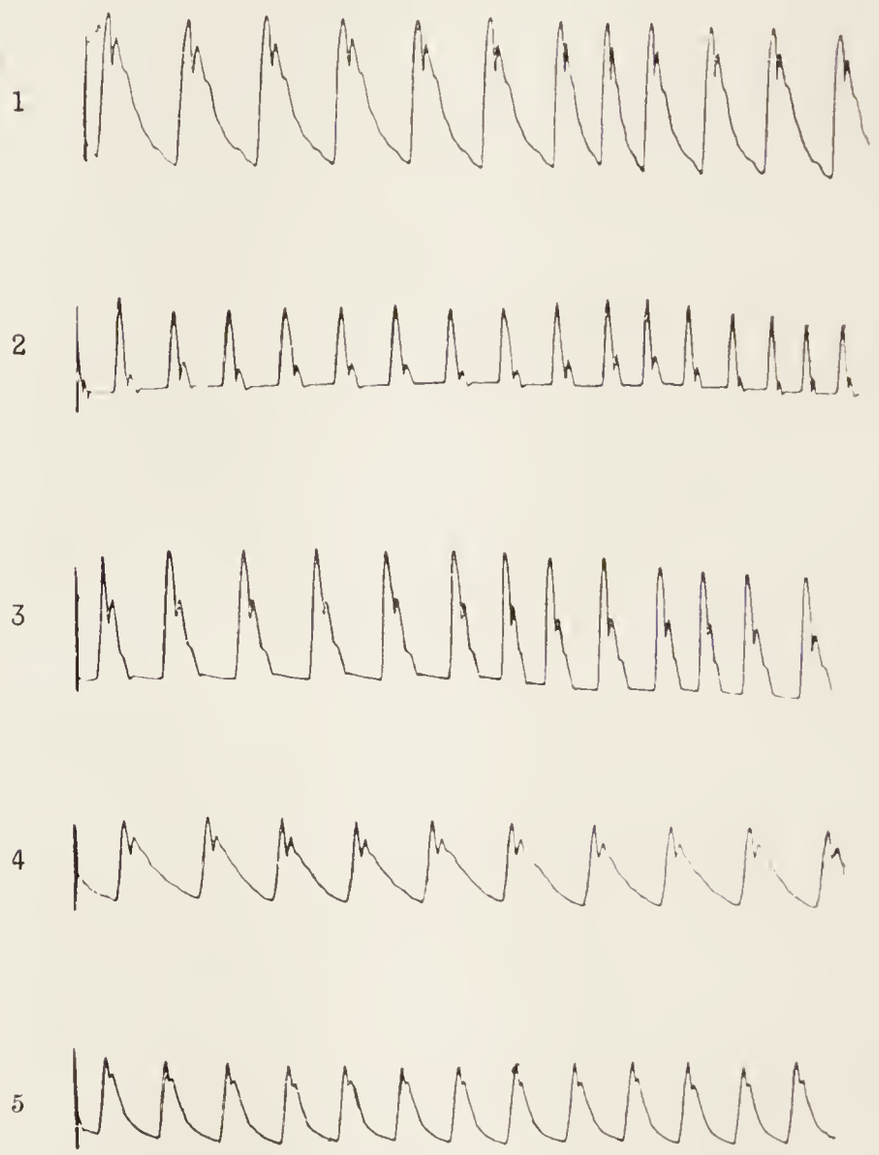
[2] Transactions of the Pathological Society of London, vol. xxvii. also Dextral Valvular Disease of the Heart, Graduation Thesis, 1878, p. 5.

[3] Vol. iv., p. 252.

became useless. The pain was relieved by standing up and became worse when lying down. This fact, in view of the nature of his valvular lesion, is interesting. On the advice of a medical man he lay in bed on one occasion for three weeks continuously and rose from the recumbent position for no purpose. He steadily grew worse and his pain became more severe. He took nitrite of amyl as an inhalation with benefit. He had the usual physical signs of aortic regurgitant disease. The bruit was loud, diastolic, and of a highly musical quality. On Nov. 7th, about seven months after I had first seen him, he had an attack of angina while I was examining his heart. The organ quickened in action and the pulmonary second sound became markedly accentuated, while the aortic diastolic bruit became less audible. He then inhaled a capsule of nitrite of amyl. After a short time the accentuated pulmonary second sound became less audible and the heart's action became slower and slightly irregular, the musical diastolic bruit being occasionally loud and prolonged, and again soft and short, and then pain passed off. The patient persistently refused to become an in-patient of the hospital, as he dreaded recumbency, and, wishing to use the sphygmograph and to examine the patient with more leisure, I asked him to call at my house. The following particulars I transcribe from the article to which I have referred: "When I had taken a tracing an attack of severe angina supervened. The patient at once rose and grasped his left wrist tightly with his right hand. I persuaded him to sit down and took a tracing as well as possible under the circumstances. He crushed and inhaled a capsule of nitrite of amyl while I was doing so. I was thus fortunate enough to get a tracing of his pulse when the drug had begun to act and another when the pain had just passed off. These tracings, taken in connexion with the observations on the patient's heart during the attack which I have already mentioned, appear to me of theoretical and practical interest. The patient did not again present himself at the hospital until Jan. 16th, 1895, when he seemed in all respects better. He had gained flesh, been more free from pain, and slept better in the interval between attacks. He consulted me as he had not recently been quite so free from pain. On examination I found the apex beat in the fifth space slightly inside the nipple-line, the transverse measurement of the heart four and a half to five inches, and the bruit in the same situation as formerly, but though still distinctly musical, rather less so. A sphygmogram of the right radial artery was taken while the patient was seated and may be regarded as normal for him (Fig. 9). These sphygmograms, some of which are not all that could be desired, are sufficiently instructive on examination. No. 1 represents a characteristic tracing of apparently pure (and uncompensated) aortic regurgitation under low pressure. The pressure was, however, sufficient to produce an accurate

reading. It was very little less than one and a quarter ounces, which was that registered by the instrument (Dudgeon's) when the three following sphygmograms were taken. The latter—namely, Nos. 2, 3, and 4—were taken

FIG. 9.



1. Aortic reflux; uncompensated; right radial; patient seated. 2. The same; left radial; seated; attack of pain. 3. The same; pain subsiding under amyl nitrite. 4. The same; pain quite subsided under amyl nitrite. 5. The same; compensation temporarily established.

with the hand in one position and at one application of the instrument. It will be observed that the predicrotic wave, which is well marked near the summit of the normal tracing (that is, of the tracing before angina), has fallen considerably during the attack (No. 2) and tends gradually to

rise after the inhalation of the nitrite (No. 3) ; while it has all but attained its original level when the patient declared himself free from pain (No. 4). During the paroxysm (No. 2) it will also be noted that the wrist pulse has shrunk away from the instrument during cardiac diastole, but not sufficiently to obliterate its diagnostic undulations ; while in No. 3, when the nitrite had begun to act, it raised the lever in a manner more resembling the normal tracing (No. 1) than that of complete post-nitrite relief (No. 4) when the dilated and refilled vessel pressed with greater force on the lever, as is evidenced by the moderately high upstroke, the return of the predicrotic wave to its normal level, and the full and quiet swing of the whole sphygmogram. A notable characteristic of the tracing of the attack at its height (No. 2) and of that showing commencing relief from the inhalation of the nitrite is the flat-drag of the dicrotic or pre-percussional portion of the sphygmogram. This was not due to accidental impediment, or other disturbance in the action of the instrument, but, in my opinion, to the fact that during that time the collapsed vessel was not in effective contact with the sphygmograph, which recorded an almost straight drag in consequence. This is less apparent in No. 3 than in No. 2, but is nevertheless well marked in it. In No. 4, on the other hand, the vessel has filled so as to be in good and constant contact with the lever and registers the tracing of normal repletion and pressure."

If this interpretation of these tracings be correct and the practical abolition of the bruit together with the increased accentuation of the pulmonary second sound be borne in mind, we have to deal in such a case with an inhibited heart and a collapsed, not actively contracted or bespasmed, peripheral arterial system. These *consequences*, however, do not explain the *cause* of the pain. While in such cases the distended or dilated ventricle may, on Sir Lauder Brunton's hypothesis, play an initial part in the etiology—the part of the uncompensated ventricle—this factor does not, it appears to me, explain the widespread pain, involving in this case both right and left brachio-thoracic nerve paths and extending even to the body generally. While in sympathy in all such matters with the exclamation of Francis Bacon—*hypotheses non fingo*—there is a dim twilight in the human knowledge of any natural phenomenon in which the mind of man *will* struggle to explain the obscure as best it can. As it appears to me, in view of all the facts we have gleaned, the most probable cause of, and most powerful factor in producing, this widespread distress in such an aortic lesion as that just described, is the distensive throb of the blood cast by a dilated yet powerful ventricle into the aorta and coronary system. To this supposition the same objection may be urged as that which occurred to Professor Osler in criticising Sir Lauder Brunton's theory—namely, that if the above supposition be

correct, why do not these consequences follow more frequently?

Now, in connexion with the lesion mentioned such attacks may occur with considerable frequency, and in the particular case I have quoted they occurred with great frequency, especially when lying down. Thus I have the following note concerning the experience of the patient on June 25th, 1894: "Went to bed at 10 P.M., slept at once for three-quarters of an hour, when he was awakened by pain in the præcordia, passing down to the left wrist on the ulnar side. Duration of attack 5 to 10 minutes, when he slept again. Was wakened every hour by the same pain." These remarks lead us by a natural transition to the consideration of so-called vaso-motor angina and to inquiry whether the peripheral constriction of vessels observed in some such cases is a *cause* of the cardiac pain, or whether the conditions at the periphery are a *consequence* of the agony at the heart.

Vaso-motor angina.—That the arterial periphery under the influence of the nervous system varies in calibre, and therefore in permeability, is a fact too well recognised in physiology to be called in question. That this condition, until relieved by vaso-dilatation, raises the general blood pressure in the body is equally indisputable. That a diminution in size and an increase in tone of the larger peripheral vessels, notably of the radials, have been observed antecedently to, and during attacks of, angina pectoris by physicians of recognised ability and experience establishes beyond cavil the fact that such changes are, if not invariably certainly in many cases, associated with the painful affection we have been studying. That agents under the influence of which such peripheral arterial tone is reduced likewise relieve the central pain has been the gratifying experience of many since Sir Lauder Brunton, guided by the physiological experiments of Dr. Arthur Gamgee, then of Edinburgh and now of Montreux, first used nitrite of amyl in 1866 for the cardiac pain of a patient in the Edinburgh Royal Infirmary who was suffering from aortic valvular angina. That the pulse, however, is not always spasmodically narrowed in angina is a clinical fact as indisputable, in my opinion, as that it is at times so narrowed. That the blood pressure at the periphery, even in that form of endocardial angina so often associated with aortic valvular disease, is on occasion one of peripheral depletion from cardiac inhibition rather than of repletion from peripheral spasm I have endeavoured to maintain in the preceding section. But it may freely be admitted that vaso-motor angina with or, as in Nothnagel's[4] cases, without central lesions may be accepted as a clinical fact. This done, however, are we in all such cases dealing with a pain provoked in the first instance by peripheral arterial resistance, or is the peripheral spasm, if such occur, a consequence in some cases, if not in all, of the centrally experienced pain?

[4] Deutsches Archiv für Klinische Medicin, 1867.

It is well in such a discussion to have a clear conception of the meaning of the terms used. Nothnagel was not the first to coin the term "angina vaso-motoria." Landois[5] preceded him, but did not attach the same meaning to the term as Nothnagel did. It is certain that many now describe cases as vaso-motor which have little in common with those which Nothnagel had in view when he wrote his paper. His cases appear to have been a sort of generalised migraine without the headache, in which the prognosis was always favourable, the patients usually quite recovering. In association with very pronounced cardiac pain they are not common, so far as my experience goes, and I am glad to find that I am not singular in this respect, as Dr. J. Mackenzie of Burnley[6] in his recent work expresses the same opinion. The germ of Nothnagel's interpretation of his anginous cases may be observed in the paper which he published a year earlier in the same journal[7] on the Doctrine of Vaso-motor Neuroses.

That such agencies as cold, emotional excitement, reflex disturbances from various organs, and certain poisons such as tobacco may prove to be at times, may commence the vicious cycle by inducing the peripheral spasm which finds expression in angina we may rationally admit. But that such peripheral conditions, even in these circumstances, require the presence at the centre of some state or states in the majority of cases, which aid the peripheral resistance to find expression in pain, is, I imagine, in view of all the facts we have investigated, quite indisputable. Given a weak spot at the centre, capable of registering a rise of pressure in the vascular system, that rise may be registered as pain, however the increase of pressure be brought about, whether by central propulsion or peripheral resistance. But that a patient with dissecting aneurysm of the coronary artery, with neuritic processes active in the aorta and coronary system, and with a delicate and minute innervation of every fibre in the cardiac muscle should invariably wait upon the remote periphery for the signal of distress is simply unthinkable and may even be regarded as an opinion no longer tenable. In speaking thus strongly for the central origin of angina in many cases, apart from considerations of peripheral blood pressure, I am glad to have the support also of so well known an authority as Professor Clifford Allbutt. If a stimulus arising in the gastro-intestinal tract can alter the conditions of peripheral blood pressure ; if the emotional distress caused by such a stimulus may aggravate, alter, or vary such peripheral manifestations of disturbance, may not a pain, among the most agonising of those which the body can experience, and associated with more emotional disturbance than most of them, play the major rôle in altering the state of the peripheral circulation ?

[5] Correspondenzblatt für Psychiatrie, 1866.
[6] The Study of the Pulse, Edinburgh, 1902, p. 78.
[7] Deutsches Archiv, Band ii., p. 173.

Surely the question has only to be asked to be answered in the affirmative. "May not this rise," asks Professor Clifford Allbutt,[8] "be rather a consequence than a cause of angina?" I think we may now unhesitatingly answer yes, in the majority of cases.

Compound angina pectoris.—We have now examined, with such fulness as the time at our disposal will permit, the various elements capable of playing a part in the complex clinical picture of painful angina pectoris. But this very complexity argues the participation of more factors than one in many cases. As was maintained in the introduction to these lectures the functional unit is not single but at least triple and in the case of the heart and vascular system consists of muscle cell, blood, and nerves. These factors, playing as they do a triune part in the physiology of the organ, frequently play likewise a triune part in the pathology of the organ and evolve by their coöperation the clinical entity compound angina pectoris, into which category most cases of the disorder must of necessity fall. "I urge, then," writes Professor Clifford Allbutt, "that, although often an epi-phenomenon of aortic valvular disease, there is in angina pectoris a *tertium quid* which marks it as something apart from the crowd of heart diseases and from mere spasmodic neurosis. Structural disease of the heart itself, in a conspicuous sense, may not be an essential part of angina; it may be a contingent, but an indispensable condition." He then refers[9] to "a grave and mortal case" reported by myself to support this contention, and is good enough to regard it as "described minutely." Such minuteness of description, however, as the case received when I first published it was insufficient, for after the lapse of seven years I decalcified the right coronary artery from this case and found in it both the internal aneurysm and the inflamed and degenerated nervous structures which I have already described, conditions which, under the influence of varying pressure in the circulation, appear to me to supply, at least in *this* case, the *tertium quid* we are in search of. The major rôle in compound angina may be taken by one or other of the factors named in different cases. The cardiac muscle may hold in unrelaxing grip the sensitive nerve endings which wander among its fibres; the character of the blood and its quantity and impulse may influence the vitality of muscle and nerves alike, and irritation or inflammation of the nervous mechanism may, directly or indirectly, disturb the other partners in the functional action of the organ. The determination of the point as to which of these factors plays the leading part in any given case belongs to the diagnosis of one kind of angina pectoris from another—a task always of the highest interest to attempt to determine and likewise

[8] Lane Lectures, p. 109. [9] Ibid., p. 93.

at times most difficult. Before essaying this task, however imperfectly, it is necessary to consider shortly that condition which is usually regarded as closely allied to Heberden's disease and to which Sir William Gairdner has given the name of "angina sine dolore"—anguish without pain.

Angina sine dolore.—In dealing with painless angina Sir William Gairdner[10] throws a wide net and incloses a large series of cases, syncopal in nature and associated with a distressing and apprehensive mental state. He includes cases of aortic regurgitation with "anxiety" and "cardiac oppression" but without pain and cases not necessarily associated with valvular disease in which the apprehensive fears of the patient find expression in restless movements and even in cries of distress but in which there is also no physical pain. Wont and use have made us acquainted with the clinical significance of many terms and, as I have already stated, the first step in the determination of the nature of a disease is necessarily its recognition from the symptoms manifested and its designation very frequently by some term denoting those symptoms. The nature of angina sine dolore, however, appears, with the exception of the mental anguish associated with it, to be in most cases though not in all the very antithesis of angina *cum* dolore—Heberden's angina pectoris. In the latter the flaccid syncopal heart found post mortem is the final event in a series: in the former the syncopal state appears to be the essence of the situation. In Heberden's disease the syncope is largely inhibitory and only follows an agony which would blanch the face and stop the pulse did it occur in the foot instead of in the heart or its vicinity. In angina *sine* dolore the sensory nerves are free from stimulation; there is no pain, but the patient, even if a brave man and one who can look the King of Terrors in the face with composure, feels instinctively, though free from pain, that he is on the brink of dissolution. This is a point at which the two categories of cases most nearly approach one another. The whole phenomena, however, of angina sine dolore are relaxant—syncopal. The *tertium quid* which determines *pain* is absent or in abeyance. No theory of cramp could ever have been suggested to explain the phenomena of the majority of cases of angina sine dolore.

The anatomical and other conditions which underlie the two states may, in many cases, have much in common. The age, sex, and circumstances of the patients may be much the same. The cases may touch each other in the matter of atheromatous and calcareous states of the aorta, coronary arteries, and valvular apparatus of the heart, but these resemblances cannot bridge the gulf which lies between them, the gulf of pain in the one case and of no

[10] Op. cit., p. 565, et seq.

pain in the other. Cases, no doubt, are met with which have evinced the pain of angina at one time or another and ultimately die in a syncopal manner without such manifestation. These must be placed in the category of Heberden's disease. They possess the underlying condition which provokes the *tertium quid* of pain. This cases of pure angina sine dolore presumably do not. Indeed, had not so revered a teacher as the veteran clinician who coined the term "angina sine dolore" placed these words in currency one would have felt inclined to suggest some such term as "syncope trepidosa" (with a due apology to the classics) as expressing more clearly the nature of most, though not perhaps of all, cases of the disorder.

In his lecture upon the "Allied and Associated Conditions of Angina Pectoris" Professor Osler[11] includes Parry's syncope anginosa, the Adams-Stokes syndrome, angina sine dolore, and cardiac asthma. The term used by Parry accurately conveys the idea of pain and fainting, but as Osler points out syncope in this connexion is chiefly applicable to the fatal paroxysm, and I would add to the last phase of the fatal paroxysm which I regard as the syncope following an inhibitory action of the vagus. The phenomena of cardiac asthma, as emphasised when dealing with endocardial angina, may be associated with a syncopal state of the ventricle and with depletion, not repletion, of the periphery, but they may also be associated with the highest degree of pain, thoracic and brachio-thoracic. These two classes of cases, then, I should feel disposed to separate sharply from the category of painless angina. The Adams-Stokes syndrome, on the other hand, which is essentially syncopal in nature, appears to me to belong to the same category as the condition now under consideration. The anatomical basis and circumstances of many of these cases closely resemble those associated with cases of angina pectoris and their sharper distinction one from another, apart from such considerations as pulse-rate, mental distress, and final syncope, can only be rendered clear by persistent and painstaking anatomical investigation.

Of the varieties of angina sine dolore there seem to be three chief classes :—1. Those which evince alike the fears of impending dissolution and reveal the fact of syncope in the action of the pulse and of the heart. 2. Those which exhibit the mental phenomena in a very marked degree, but which reveal no sign of imminent syncope to physical examination. 3. Those which manifest the persistently slow, and it may be intermittent, pulse of the clinical picture first painted by Adams and varnished and framed by Stokes, but in which the syncopal element is more pronounced as the breakdown is more sudden. The chronic bradycardial case may ultimately manifest angina sine dolore, but he may faint into oblivion without either mental distress or pain,

[11] Op. cit., p. 67 et seq.

and in the absence of both pain and distress must be excluded from the cases we are discussing.

Those cases which may be placed in the first of these classes are of comparatively common occurrence and we have probably all met with them. Thus in September, 1901, I was consulted by a gentleman, 60 years of age, short, stout, a careful liver, and retired from business, but who at one time suffered a great deal from gout. He complained of occasional attacks of what he termed "breathlessness," especially if exerting himself in any way or excited. These attacks were associated with a sense of weakness and a cold perspiration of the face and caused him alarm. He stated that he suffered from palpitation during these attacks but experienced no pain. His pulse when I saw him was 78 and regular but feeble; his heart's action also was regular but the sounds were distant and not forcible There was no cardiac bruit. The other organs were normal. I prescribed a cardiac stimulant, small doses of calomel and rhubarb, and trinitrin for the attacks, advising him also to drink good and expensive tea as a stimulant rather than alcohol with his meals. He consulted me again a fortnight later and informed me that his attacks of "breathlessness" were of shorter duration and of less frequent occurrence; he stated that he felt in every way better and thanked me especially for advising him to drink the expensive tea which I had named, speaking enthusiastically of it as "life to him." He had a house in the country and left town to reside there. About a month after the date of his last consultation with me I received a note from his medical attendant who informed me that he had been hastily summoned to him during the supervention of one of his attacks of breathlessness and faintness associated with cold perspiration and a failing pulse, and that although pain was not complained of the patient died after having been about two hours in the condition described.

Of that variety of angina sine dolore in which no evidence of syncopal failure can be detected on physical examination I have never myself met with an example; nor, indeed, have I ever met with angina of any description in which some variation of pulse from its normal condition could not be detected by the finger or registered by the sphygmograph. Heberden probably did not intend to apply absolutely his statement, "*Arteriae eorum qui in hoc dolore sunt, naturaliter prorsus moventur.*" That it cannot be so applied in painful angina we now know full well, but this anomalous condition appears to occur on rare occasions in angina pectoris. It is, I should imagine, equally rare, or nearly equally rare, in angina sine dolore, for trepidation is present here though no physical pain. Professor Clifford Allbutt has well described one such case in his lectures already mentioned (p. 113). It was that of a gentleman advanced in years who had the usual signs of senile heart and thickened arteries. "All at once," writes Professor Allbutt, "when

my examination was nearly over, he said in a hollow voice, 'It is coming,' and his nurse, familiar with the cry, ran forward with restoratives—with brandy or sol volatile. The face was then ashen and terror-stricken, and he was frozen into an attitude of stillness ; he did not even disengage his wrist from my finger, which, fortunately, was then resting on his pulse. In spite of smelling salts and other restoratives of the ordinary kind he was thus held in deadly apprehension for some minutes ; as the seizure began to pass off he whispered to me, 'It will kill me.' During all this time his pulse, already somewhat hard, never faltered or underwent any change whatever. There were no vaso-motor phenomena. ..... The patient assured me that he had never had the least pain during any of these seizures."

We know that there are cases of "cardial" as distinguished from "extra-cardial bradycardia," to use Dehio's expression,[12] which cannot be accelerated either by stimulants or exertion, and it is conceivable that in an analogous condition circumstances which, under more normal conditions would provoke variation, fail to do so here. But the immobility of pulse in such a case would be something apart from its associated angina, whether painful or painless. It would be of interest to learn in all such instances what the habitual behaviour of the heart's action had been.

Of the third class of angina sine dolore—that, namely, in which cardiac failure occurs with a slow pulse which intermits at intervals and is varied by short periods of acceleration only to be followed by another intermission more or less profound—the clinical picture may be a very striking one. It is essentially an acute syncopal bradycardia.

Some years ago I met with a well-marked instance of this affection. The patient was a tall, stout man, 71 years of age, wealthy, and a voluptuary. As a younger man he had been very powerful and a good amateur pugilist. He had eaten and drunk to excess over a considerable portion of his life, but he flattered himself that he had acted rather prudently than otherwise, as he invariably only consumed "the best," as he termed it. Although he weighed 22 stones at the time of his death his arteries at the wrist were soft for his age, his heart exhibited no abnormal signs, and his kidneys were healthy. The seizure I am about to record occurred in the month of January. The weather was intensely cold at the time and the patient had had a mild bronchial attack, but being much depressed by the death of his only son he had gone to a theatre with his comparatively young second wife to escape from his worry. He had a syncopal attack during the play and was brought home in a cab. I saw him at midnight. He was seated in a chair in his dining-room, quite conscious, with a pallid face and cold and clammy surface. His pulse-rate was 30 and full and his

[12] St. Petersburger Medicinische Wochenschrift, 1892, No. 1.

respiration-rate about the same. I directed him to be laid on the floor and supported by pillows, for the conveyance of 22-stone-weight in a syncopal condition to bed was difficult. At short intervals his pulse failed entirely and with the complete failure of the pulse at the wrist the patient shouted loudly, feeling his consciousness about to leave him. He never, however, at this stage completely lost consciousness except when he slept for a few minutes. During one such short interval of sleep his pulse suddenly failed and the patient awoke shouting in alarm as he did in the same circumstances when awake. The pulse during this time behaved as follows. Immediately after complete failure it slowly rose to 24 a minute, remained for a time at 30 a minute, then rose to 42, 54, and even 72 and 90. Every such acceleration was followed by complete failure and the alarmed shouting I have already described. It was a veritable syncope trepidosa. At no time had the patient any cardiac pain. It was an angina sine dolore. I regret that I have no sphygmograms of this case, but very good tracings of a somewhat similar but less acute case will be found in Dr. Alfred Webster's article on Cardiac Arrhythmia in Relation to Cerebral Anæmia and Epileptiform Crises in the Glasgow Hospital Reports for 1901. Under the influence of hypodermic injections of strychnine and strophanthus, and other remedies, including tincture of belladonna, coupled with the absolute quiescence of recumbency, the syncopal attacks became less frequent, but when they occurred, as they did at intervals, they were associated with the phenomena already described. The patient was under my continuous observation throughout the night and I left him for an hour at six in the morning. I again saw him at seven o'clock, when I found that he had had no return of syncope during my absence. His pulse-rate was then 36 and regular, and his respiration-rate was 30. Only the first sound of his heart could be heard, which was distant and muffled and associated with a murmurish vibration but without actual bruit. Between this time and one o'clock in the afternoon of the same day the patient improved considerably, and at the hour mentioned his pulse-rate was 54 and regular, and its impulse so strong to palpation that I felt inclined to advise him to abandon recumbency for a sitting posture but decided not to do so. He expressed himself as feeling much better. At five in the afternoon he supposed he was out of danger, but I found that his pulse force was less than at one o'clock. Soon afterwards he had a syncopal attack associated with epileptiform signs, in which he became cyanosed and rigid. This attack passed off and the patient again became comparatively comfortable and I left him. Shortly afterwards syncopal failure again took place and the patient, I was informed, died without any struggle. There was no post-mortem examination of the body.

The conclusion which I draw from this study of the anatomy, physiology, pathology, and clinical history of

angina pectoris is, that, notwithstanding the very able defence of an untenable position, as I regard it, by M. Henri Huchard and those who agree with him, the exclusively arterial view of the malady must be abandoned. The rôle of the blood-vessels *regarded as hæmaducts has been exaggerated.* The blood-vessel is more than a *hæmaduct.* It is, like the heart itself, a muscular organ, innervated, irrigated, mobile, and capable, like the greater organ, of being disabled in one or more of its triple constituents—its muscle, its blood-supply, and its nerves. It is capable of being the seat of pain chiefly through such destructive processes as influence or lay bare its sensitive structures—its nerves—and by the agony of such pain of influencing indirectly the heart itself. But what is true of the blood-vessels of the heart is likewise true of extra-cardiac blood-vessels, of the aorta, and even of distant organs only in general connexion through the nervous system and blood with the heart. Indeed, hepatic colic may very closely resemble angina and kill indirectly, just as neuritic angina from whatever cause does. M. Huchard [13] would probably accuse me, in making this statement, of falling into a triple error—"historical, nosological, and clinical." But I confess that his endeavour to demonstrate this threefold mistake and on all three of these points would appear to me to be entirely fallacious and wholly inconclusive.[14] It would be fallacious historically, because innumerable cases of coronary disease have been recorded in which there has been no angina pectoris; it would be fallacious nosologically, because lesions have been demonstrated irrespective of the character of those vessels as hæmaducts which are rationally capable of being regarded as provocative of angina; and it would be fallacious clinically, because M. Huchard insists that a very limited amount of atheroma of the coronary arteries is capable of accounting for attacks of breast pang, and we have every reason to believe that a certain amount of arterial atheroma after middle age is the rule rather than the exception and yet cases of angina pectoris are comparatively rare. If, therefore, the continent of the syndrome of angina pectoris be one and indivisible it has likewise its countries, elements, or varieties, and the initiative in modifying the condition of other members of the confederacy may be taken by any one of them. Angina pectoris, I therefore maintain in opposition to M. Huchard and those who agree with him, is not one *except in suffering*, but essentially threefold—muscular, neuritic, and hæmic. As regards etiology, I hold that it is not a rise of blood pressure as such which is causative of angina, as a rule, but blood pressure in many cases, whether propulsive or obstructive, exercising its influence upon local anatomical lesions or strained physiological structures in the heart or its immediate neighbourhood.

[13] Op. cit., p. 652.

[14] Loc. cit.

LECTURE IV.

Delivered on July 7th.

On the Diagnosis, Prognosis, and Treatment of Cardiac Pain.

Gentlemen,—The diagnosis, in its widest sense, of angina pectoris includes not only the discrimination of varieties of that malady from one another but that of the syndrome of angina from other conditions which in some measure resemble it yet affect quite other structures than those involved in Heberden's disease. For this general diagnosis three chief points have to be borne in mind and usually serve to exclude ailments which can only be mistaken for angina when their indications are imperfectly regarded. These guiding points are: (1) the situation of the pain; (2) the character of the consequences of the pain; and (3) the fact as to whether or not the act of respiration, especially in its voluntarily exaggerated execution, is in any way impeded or tends to influence the degree of pain. The site of pain in all varieties of angina pectoris is, in almost all instances, chiefly in the anatomical situation with reference to the surface of those structures, lesions of which we have found to be associated with Heberden's disease. That site is essentially sternal or retro-sternal, and most commonly some point between the level of the third rib cartilages and the ensiform process. Cardiac pain is practically central and in the situation indicated. It is rarely epigastric or over the manubrium sterni. The patient in an attack when asked to place his hand over the seat of pain lays it over the centre of the sternum, and only in the second place describes the brachio-thoracic or other direction of radiation, if such be present. This fact serves to distinguish angina almost always from sub-diaphragmatic pain, whether of a functional or organic character, in the higher abdominal viscera. With the character of the consequences of cardiac pain we have already dealt at length in discussing the clinical history of the disease. While the general collapse which is observed as a consequence of hepatic, renal, or other severe pain may bear some resemblance to that of the later stages of an anginal attack, the characteristic radiation of the pain in cardiac cases usually serves to indicate on well-known

anatomical lines the source or seat of the original stimulation. Collapse due to non-cardiac pain, moreover, is usually of later supervention than when due to angina pectoris. The last point—namely, the freedom of respiration and especially the unimpeded character of forced or voluntary respiration—serves to distinguish between cardiac and other thoracic pains whether direct or reflex, which, by affecting the intercostal, diaphragmatic, or other muscles exercised in forced respiration, indicate the structures involved. "From the disease itself," as Heberden remarks, "those who are affected experience no difficulty in breathing, by which circumstance this breast-pang is chiefly distinguished."[1] The patient's respiration, like his pulse, may, indeed, be temporarily arrested while in the agony of angina, but if he be asked to take a deep breath he can do so without impediment to respiratory movement or increase of pain. These considerations, borne well in mind, will usually serve to guide us aright in the diagnosis of angina pectoris from pain affecting structures other than the heart. Mistakes will doubtless occur and exceptional and perplexing cases be met with even when these points are remembered, but such exceptions only serve to prove the value of what is a practical and safe clinical guide in this important matter.

By the more particular diagnosis of angina pectoris I mean, not only the discrimination of so-called true from false angina, but the distinguishing of varieties of true angina from one another. If the first task be at times difficult, and even when every precaution to come to a right decision has been taken results occasionally in error, how much more frequently must this be the case when we essay the second. There are cases of "true" angina to witness the phenomena of which is to have them indelibly fixed in memory and on the same conditions presenting themselves again they lead to the recognition of that state with promptitude. The clinical histories of the varieties of angina which I have already related contain examples of such. But there are other cases which so closely, in some particulars, resemble those I have mentioned, that it is only by a close consideration of details that we can detect where the resemblance ceases. Even after every care has been taken, however, and we have formed, it may be, a comparatively favourable prognosis, error may occur. As I have already contended, true and false are unfortunate terms to apply to angina unless we have a clear notion of what we imply by their use. If we mean by the former to designate cases which always threaten, and, in the vast majority of cases, sooner or later destroy, life, while by the latter we denote cases which, whatever the degree of distress they exhibit, very rarely indeed or never kill, we may be justified for convenience sake in making this distinction. As, however, the pain of a fatal angina may not to all

[1] Commentarii, p. 309.

appearance be so excruciating as that in cases which recur frequently and disappear apparently for lengthened periods or altogether—although the fact of suffering, of angina, is indisputable and real in both cases—its mere degree cannot be taken as a measure of its seriousness. Dr. G. A. Gibson, in his recent lectures on the Nervous Affections of the Heart,[2] also expresses his objection to a distinction being drawn between varieties of cardiac pain as true and false.

The criteria which distinguish cases which are dangerous from those which are not are only to be gathered from a comprehensive view of the circumstances of each case—a view which comprises the whole of the clinical picture and properly appraises the diagnostic value of special points or details. A margin for error must be left even then, for there are probably cases of which we may say with the poet, "There is no name for that of which she died." It is, however, probable that the sex of the deceased to whom the Poet Laureate applied these words in his Human Tragedy would exclude angina pectoris. I say this is probable, for a comparatively small number of women undoubtedly die from an angina which may long have been regarded as a mere manifestation of a troublesome dyspepsia. This was the fate of an elderly woman whom I saw as an out-patient at the Great Northern Central Hospital. Sex, however, is an important factor in this relation and of two patients, one a man and the other a woman, who manifest symptoms of angina the former will with incalculably greater frequency be found to harbour the fatal variety of the affection. Although cases of fatal angina in early life have been recorded and even atheroma has been demonstrated on rare occasions in the "teens" or earlier, as in a specimen which I show you, if we exclude the consequences of syphilis and the general debauchery to which man is at times addicted in earlier life, Heberden's indication of the fiftieth year, the average period of the commencement of atheromatous wear and tear of the vessels, may be regarded as a valuable element in the diagnosis of cases which manifest cardiac pain. At a still later period, say between 60 and 70 years of age, to pronounce a man sound at heart and to prescribe gymnastics, wood-cutting, and so forth because of a well-preserved softness of radial pulse and the absence of detectable cardiac lesion is, in many cases, to court the disaster which overtook one of the cases the history of which I have related. To be over 50 years of age, then, and to evince angina is to suggest, though not to prove, the presence of the dangerous kind.

Heredity, again, has a certain influence and has to be reckoned as a factor in diagnosis. The father of my patient who died from musculo-spasmodic angina died similarly suddenly when about to leave his house to conduct a religious

[2] Edinburgh Medical Journal, 1902.

service, for he was a clergyman. The anginous family history of the Arnolds is common knowledge. When the neurotic disposition is unassociated with a proneness to vascular degeneration, in the production of which gout is a frequent factor, angina is more likely to be less dangerous and more transient than when these dispositions are combined, as they frequently are, in cultured families and in those who exercise intellectual professions. Woman, whose frequently much-enduring but more refined constitution than that of man makes her more often than the latter the subject of the less dangerous variety, is also an illustration of this fact. In the death-grip of true angina, moreover, the patient is usually stilled into quietude by his agony and feels that his summons to pass into the unknown has come. In the agony of so-called false angina he frequently, indeed, fears that death is imminent, but he manifests more excitement and energetically endeavours to break loose from the grasp that threatens to detain him. Yet it must be confessed that these general impressions, although they have a certain value, are not altogether trustworthy, and the man who off-hand, from such considerations, pronounces definitely for or against the presence of the dangerous or innocuous variety, as the case may be, may find himself sooner or later admonished by the event that wisdom lies in exercising the greatest caution in expressing too positive an opinion. Given a comparatively young subject with normal radial arteries, be they tense or otherwise, free from local heart affection or other organic disease, and without the history of that ubiquitous agent for vascular evil—syphilis—we shall in most cases be justified in looking for a transient cause of angina and the disappearance of the effects of such. On the other hand, given a man (or it may be a woman) past the meridian of life, or with the evidence of local disease, or having an indubitable specific history, we may be fairly certain that Death has not only beckoned the patient, but will in many cases return at no distant date and insist upon his following him.

Admitting, however, that we are in certain cases concerned with angina vera or the lethal type, is it possible to determine in any way the particular variety of the fatal malady with which we have to deal? For example, is the case before us one of coronary calcification with neuritis, or it may be aneurysm, or is it one of musculo-spasmodic angina? In considering the point I am aware that I am treading upon altogether disputable ground and desire to avoid any appearance of a presumptuous dogmatism, but, nevertheless, I wish to point out some considerations which appear to have weight. The age of two such patients may not help us very much, but it is a point not to be dismissed hastily. Taking 50 years as the average age for commencing atheroma in normal circumstances—the period at which the normal wear and tear of life begins

to tell on the blood-vessels—it is unquestionable that those cases which ultimately reveal calcification of the coronaries may exhibit the first evidence of angina considerably earlier. It is unnecessary to refer at length to the classical case of John Hunter, the clinical details of which have come down to us from Sir Everard Home and have been studied with care and rendered still more current knowledge by Sir William Gairdner. Born in 1729, he had the first attack of gout in 1769, his first angina in 1773, his second attack in 1776, and a more continuous status anginosus was established in 1785 which ended in death in an attack in 1793 when he was 64 years of age. My own patient, whose case I have related, died at the age of 54 years after having suffered from angina for seven years but with progressive frequency in the latter portion of that period, and also died during a paroxysm. During the 10 years prior to his death he had four times suffered from gout in the great toe. Both these cases, therefore, must early have manifested coronary atheroma and probably, likewise early, the calcareous change in the vessels. In the case of my own patient I explain the earlier symptoms by neuritis and the later and more continuous by neuritis and aneurysm. Time alone can show whether this conclusion, which is probably correct for the case in question, is of more general application.

The sufferer from musculo-spasmodic angina may quite possibly be affected as early as the patient from coronary neuritic angina, but in all probability, in such a case, some sufficient cause of muscular exhaustion will be found in the events immediately antecedent to the attack which may point to the muscular factor playing the major rôle in the tragedy. The arthritic history may likewise be absent, although not necessarily. But, questionable as these criteria may be, I think there is a less doubtful value to be attached to the general type of the sufferer. The canvas of Sir Joshua Reynolds, painted in 1787, and Sharp's fine engraving made at the same date after repeated attacks of the malady had probably borne in upon the mind of the great student the true significance of his pain, have brought down to us the keen, alert, and cogitative face of Hunter, associated with a body naturally powerful and, although short, certainly not stout. Those, on the other hand, who possess the heart most prone to musculo-spasmodic angina—the fatty heart—usually exhibit a general *embonpoint*. They are usually plump of face and stout in body, a stoutness in which the internal organs participate. Till now we have had to be content with such general impressions as these for the purposes of diagnosis. But are we to-day at the end of our resources when we have considered these? The fortunate accident which threw the shadow of the bones of Roentgen's hand on to the photographic plate—and how frequently the enlightening incident is an accident—seems to point to a possible solution of the difficulty on more reliable lines.

I shall presently show you on the screen a skiagram of the heart of my own patient made after death (Fig. 10). It was placed upon a celluloid plate, the light was centred over the coronaries, and it was given a short exposure of about one minute and another of four minutes. The result was equally, or nearly equally, demonstrative in both instances of the ease with which the x ray differentiates between the

FIG. 10.

Skiagram of calcareous coronary arteries. The vessel with descending branch to the left is the left coronary artery.

calcareous arteries and the surrounding textures. Such arteries in the leg and arm have been demonstrated during life and it does not seem improbable that sufficient, if not equal, success (for the organ containing them is mobile) may one day attend its use when examining the heart laterally at the level of the coronary circle. This lateral method of examining the heart naturally suggests itself, and I find that Dr. F. H. Williams in his recent work[3] draws attention to

[3] The Roentgen Rays in Medicine and Surgery, New York, 1901.

it in some detail. The limited trial I have myself made of this method in connexion with an attempt to see clearly the base of the heart inclines me to think that until some further development in the re-focussing of the rays after they issue from the Crookes's tube is made, more success is likely to attend radioscopy with the fluorescent screen than radiography. But even if by this means we cannot at present determine the existence of calcareous change in the coronary arteries themselves there is no difficulty in detecting such a condition if present in the more stationary vessels of the

FIG. 11.

Skiagram of the left leg of an old man, showing osseous tumour of the tibia and calcareous arteries. A portion of the anterior tibial only is seen in this print, but the photograph showed the vessels well.

limbs. Just as we examine the tension and character of the pulse by palpation for diagnostic purposes, so also by skiagraphy we may determine whether or not the general arterial change in a patient is associated with calcareous deposition. Thus, by an argument from the general to the particular, we may attain to a reasonable estimate of the condition of the coronary arteries of the heart, even though our conclusions may not rise to absolute certainty. Dr. Williams[4] also states

[4] Op. cit., p. 385.

that both by radioscopy and radiography calcification of portions of the ascending aorta may be detected. Fig. 11, which demonstrates calcification of the anterior and posterior tibial arteries in an old man, I found in Messrs. Coxeter's collection of prints. The case appears to have been skiagraphed on account of the osseous tumour of the tibia, the arteries revealing themselves accidentally.

That the detection of calcareous arteries in the heart or elsewhere would be of importance is unquestionable, for dealing as we probably should be, in a case with such vessels, with a fairly sound muscle, and in cases with non-calcareous arteries with a heart invaded by fat or degenerated in texture, our prognosis would be influenced by these considerations. After all the essential organ of circulation is the cardiac muscle, not the cardiac blood-vessels, and so long as the former is capable of exercising its function it is only the accident of pain arising in the latter which can bring the heart to a standstill. The case may last for years, even if in its later phase the patient should suffer much. But he who carries a degenerated heart, an enfeebled muscle, and manifests true angina is not merely at the mercy of an accident. He need not suffer pain, but he may succumb to a syncope when least expected. Nay, the very absence and comparative rarity of pain may lull him into a false security, in which he may place more weight upon the degenerated fibre than it can bear. The history of many a musculo-spasmodic angina from fatty heart is that of an organ assumed to be healthy and of its owner using it accordingly. It is, of course, possible that calcareous degeneration of the arteries may co-exist with fatty degeneration of the heart, but there is at present a lack of precise information on this point; for that minuteness of detail in examination necessary to establish the fact is wanting in the record of most cases. Even John Hunter, according to Edward Jenner,[5] overlooked the condition of the coronary arteries in a case of angina pectoris which was under the care of Heberden and I am not aware of the account of any case of angina in which the condition of the general arterial system has been examined, even when the state of the coronaries is fully dealt with. That it would be well that a general inspection of the arterial system should be undertaken in all such cases, clinically and pathologically, can scarcely be gainsaid. For a close scrutiny of the particular and a wide view of the general is admittedly the most fruitful habit of mind for the scientist. That way lies the perception of law.

The symptoms of acute aortitis, as we have learned from the clinical history of the condition, are sufficiently diagnostic and taken in connexion with the comparative youth of the sufferers and the frequent history of specific infection enable us to distinguish with some confidence this form of

[5] Parry's Syncope Anginosa, p. 3.

angina from others. Even in its more chronic phase, youth, syphilis, and the locality of pain serve to guide us in coming to a conclusion. In those cases of angina associated with aneurysm of the aorta, when other well-known criteria of this condition fail us, Roentgen radiography is invaluable. Indeed, in no sphere in which it has been employed has its value been more generally acknowledged than in this. Neuritis being a concomitant of other conditions its recognition will be regulated by the diagnosis of those states with which it is associated, but the determination of its intra- or extra-vascular seat must at present be left to the pathologist

The guide to the discovery of endocardial angina is the presence of valvular lesions and it is questionable whether intra-cardiac pressure plays more than a very subordinate part in these cases. That it plays some part is probable, for the reasons already given, but I feel disposed to think that its influence has been over-estimated. Even in the dextral valvular case I have mentioned there was an endarteritis at the commencement of the pulmonary artery which cannot be ignored as a factor in the production of pain, under the flapping stroke of the large vegetations which were attached to the valves. That the pulmonary artery, like every other artery in the body, is innervated, I satisfied myself when preparing a course of lectures on the Relation of the Nervous System to Disease and Disorder in the Viscera.[6] The syndrome of angina, coupled with various forms of peripheral dysæsthesia such as coldness of the hands and feet, disturbances of sensibility generally, and at times of motion, unassociated with valvular disease and without evidence in cardiac muscle or in blood-vessel of any of those persistent changes which we have seen to be associated with the graver varieties of the complaint, is in all probability purely vaso-motor and of favourable augury.

That most cases of angina pectoris are of compound not simple origin has been already argued, and the discrimination of one variety from another is largely merely a matter of emphasising what may appear to us to be the "predominant partner" among several factors. The absence of pain and the syncopal signs in a large number of cases of angina sine dolore will serve to distinguish this state from Heberden's disease.

The Prognosis of Angina Pectoris.

If we regard angina pectoris as one and indivisible, our prognostication of the probable issue of any particular case will be based on such a mass of dissimilar data that our prophecy, always uncertain in angina vera, to use the old collective term, must of necessity lack even a rational

[6] Edinburgh: Pentland, 1899.

degree of precision. As I have endeavoured in the preceding lectures to classify provisionally the varieties of angina, both organic and functional—to employ terms having a conventional meaning—I shall consider, in the fewest possible words, the prognosis of angina on those lines, even although the future to which we must all bow should pass a sponge over the whole slate which I have had the temerity thus to score. If we have reason to suppose that a given case is the subject of coronary vascular angina, neuritic or aneurysmal or both, how can we hold out hope of recovery from it or an amelioration of its symptoms? The process we are dealing with we know to be chronic and progressive. There is a curious rapidity in malign progress in the later phases of the disorder, as though a fresh aggravating element had been introduced. This may or may not be aneurysmal in character. That it probably sometimes is will not, I suppose, be questioned in view of the facts I have related. In the earlier and less urgent phase of this variety, then, we may guardedly and, viewing the patient as a whole and not as a coronary artery, hold out the hope, under judicious management, of a considerable length of life even though we cannot remove the sword of Damocles to a point where it may harmlessly snap the thread which suspends it. But when the progressive degeneration of the vessel has called into painful activity the slumbering sensibility of the coronary nervous system it will require little foresight to foretell a fatal issue in the near future whether the patient himself be made the participant of our belief or no. It is rarely that the physician is so fortunate as Dr. Bucknill was who had as a patient Thomas Arnold of Rugby. "He next asked," writes Dr. Bucknill, "if the disease was generally fatal. I said 'generally' (for those who knew him were aware that it was impossible not to tell him the exact truth)."[7] Thomas Arnold, however, had not, as we know, calcification of the coronaries, but probably fatty degeneration of the heart, for its external surface is reported to have been healthy, its walls thin, and the colour of the muscle pale and brown. He died in his first attack of what, according to the classification I have attempted, would be called "musculo-spasmodic angina."

What is the prognosis in this variety? A man, unconscious of any failure of power, strenuously occupied bodily and mentally, is suddenly attacked by angina and the heart, overwhelmed by pain, ceasing to beat life is extinct. Is there any reason why, if a patient recover from the actual paroxysm of such an attack, the heart muscle, which did its work so well the day prior to his death, should not continue to do it equally well if he survive the attack, provided the danger-signal raised by such an event be borne in mind? We know that death in a first attack of angina is not common whatever the underlying organic

[7] Latham's Works, vol. i., p. 455.

cause of the affection, but fulminant cases are usually associated with a state of cardiac muscle which precludes what Latham describes as the "strenuous exercise" to which "T. A." was addicted, and the continued life of such a patient must be contingent, if he survive the paroxysm, upon the abandonment of such. Any prophecy as to its duration must depend upon the impression made upon the physician of the degree of underlying cardiac degeneration which the attack has revealed. There is more hope for the degenerated heart of a fat man, speaking generally, than for the degenerated heart of a thin man. In the case of the former we shall with greater probability have to deal with fatty infiltration and a possibly healthier state of the muscular fibres of the heart than in the latter, in whom the muscle itself is more probably affected with fatty degeneration.

The prognosis of acute syphilitic aortitis must be dependent upon the extent of the affection. An extensive inflammation of the aorta associated with angina may kill, whatever its cause. The acute phase of this condition may be regarded in some sense as we do the paroxysm of angina in the cases we have already considered. Once safely over the acute stage of such an aortitis the patient, especially if his condition be rationally referable to syphilitic infection, frequently responds well to specific treatment. The angina which has been the plague of the patient and the despair of the physician often ceases to trouble, to the gratification of both, when anti-syphilitic treatment is prescribed and a favourable prognosis is accordingly justified in such a case. The prognosis of aortic aneurysmal angina is the prognosis of aneurysm, but as regards the anginous element in acute aneurysmal cases I have already given reasons for believing that pain is more characteristic of the intra-arterial than of the extra-arterial stage of its growth. The prognosis of neuritic angina has also already been considered. It is the prognosis of the probable effects of the neuritis in the situation in which it occurs, be it coronary, aortic, or extra-vascular. Inasmuch as the diagnosis of neuralgic as distinguished from neuritic angina is frequently established by the recovery of the patient it is scarcely necessary to add that its prognosis is favourable. This is also true of so-called vaso-motor angina and of anginæ reasonably referable to other than cardiac reflexes, such as poisons, tobacco, or other. "*Cessante causâ cessat et effectus.*"

The severe cardiac pain associated with valvular lesions, and particularly as has been stated with aortic lesions, being probably due to the disordered action of the organ in a condition of non-compensation or of lost compensation, and more precisely to a sudden systolic distension of the base of the aorta and of the coronary vessels, it is to be expected that on the attainment or restoration of compensation the anginal symptoms will diminish or pass off. This, the history of many of these cases, justifies us in predicting. In

using the term "distension" in this relation I do not mean spasm, like Heberden, if he be correctly believed to have used "*distentio*" in this sense, but pain from stretching. In this connexion it is of interest to note that while valvular heart disease is, as we know, very common in children, the vaso-motor phenomena associated with these lesions which we so frequently see in older subjects are among children very rare. That they occasionally occur is probable, but I confess I have never witnessed a case, say, in children under 12 or 14 years of age. Heberden states that he met with angina in a child, aged 12 years. This was probably an endocarditic case. The comparative immunity of children from this symptom seems to argue their escape as being due to the greater elasticity of young tissues, and is thus an argument in favour of the view I have expressed as to its *rationale* in older subjects. The prognosis as to pain, then, in most of these cases is probably to be guided by the prospect of the establishment or restoration of a due balance in the circulation by improved compensatory growth of the organ. The prognosis in compound cases, a class which probably includes the majority, must be governed by the prospects of that factor which is assumed or believed to play the major rôle. Angina sine dolore being essentially due to cardiac muscular failure the prognosis in this type of the affection is of the gravest. It is a musculo-paretic, not a musculo-spasmodic, condition, hence, possibly, the absence of pain. The patient is less at the mercy of an accident such as pain, but the cardiac muscle itself is near the termination of its vital possibilities.

We have now discussed the nature and causes of cardiac pain with the imperfection which is, in the present state of our knowledge, unavoidable. I fear, indeed, that I may have appeared to speak on some points with an emphasis unwarranted by the facts before us, but my action has been dictated by the belief that it is by seeking an organic basis, not of one but of several kinds, that we are likely to obtain precise knowledge of a subject which has been largely dealt with as an appalling symptom, and for the explanation of which some authors like M. Henri Huchard offer us only one key. We shall find in considering the treatment of angina pectoris that we possess no panacea. It is, I believe, equally true that for the explanation of the malady we possess no single key ; but that there are groups of cases the nature of which, however imperfectly explicable at present, will in time by patient, systematic, histological investigation be explained on more than one hypothesis ; for pathological histology is the anatomy of structural disease.

The Treatment of Angina Pectoris.

If the life be more than meat and the body than raiment, it is likewise true that the possession of life is more than a knowledge of its mechanism. The wisdom of the physician is based upon impediments to the manifestation of life and disaster attending its exercise. The physician is in a minority among men, whether as belonging to a recognised calling or profession, or whether the term be used metaphorically, as applicable to one who has learned from his own limitations to live within the compass of his powers. Notwithstanding instances of disaster to individuals it is on the whole perhaps well that caution and prudence, as regards the preservation and management of life, have not characterised mankind as a race. Many a heroic deed, many a strenuous life lost in the endeavour to reach a high ideal, would have been left unrecorded if the hero, possibly an invalid, had known and endeavoured to obey the dictates of physical prudence which such wisdom would have inculcated and had not with both hands thrown away his life for something better than life. John Hunter, who knew the serious nature of his malady, did much of his best work after angina pectoris had marked him for its own. But with such general considerations, which may be safely left to take care of themselves, like the rising and the setting of the sun, the physician who has before him a patient who has, or may have, angina pectoris is in no way concerned. The bond between him and his patient is not the potential heroism of the latter but the possibility of his demise if the dictates of physical wisdom be not obeyed, and in many cases of angina, unfortunately, whether they be obeyed or no.

Let us consider first the case of the patient who *may* develop angina pectoris. He is probably a man past the meridian of life, either spare, wiry, and it may be with a history of gout, or stout, aging, and perhaps with some history of occasional circulatory disturbance such as giddiness or breathlessness on exertion. They have both probably consulted us about some other matter altogether—dyspepsia or what not—and they have both, also probably, a degree of arterial atheroma even though the radials at the wrists or the more accessible arteries should not afford an indication to this effect on palpation. To auscultation their hearts may be perfectly sound. Let us beware in such circumstances when prescribing rules for the general conduct of their lives, dietetically or otherwise, not to allow them to go away with the impression that there is no particular need for caution in the general expenditure of their energy. The man, 50 years of age, who wishes to reach 70 years without the possible introduction of an angina into his life has to adopt an old Scottish motto, "Gang warily." The failure to inculcate this advice as regards physical exercise, especially if unwonted restrictions be placed upon the patient's diet at the same time, is, I believe, a fruitful cause of some

of the fatal attacks of angina we meet with. As a corollary to this conclusion it may be added that caution in the resumption of activity, especially in those of atheromatous age, during convalescence from debilitating ailments, influenza and other, is of the first importance in this connexion. This is especially necessary if such patients should ever have manifested any indication either of angina cum dolore or of angina sine dolore. A little more patience and caution exercised in this respect and many a valuable life might have been prolonged for a shorter or longer period, to the advantage alike of individuals and of those dependent upon them. If we inculcate such precautions in the case of one who appears to us to be a candidate for angina, how much more will it be our duty to do so in the case of those who have actually experienced an attack? We must in such cases not only indicate a suitable dietary and inexorably limit the exertion of the patient to such an amount as his own experience teaches him is safe, but also point out to him the danger of emotional excitement and the comparative safety of a calm and equable state of mind. The desirability of the attainment of this calm may be indicated by the physician; the world is too old for it to be necessary for me to add that every man must build that inexpugnable citadel of his existence for himself. Into the details of the dietary of these cases I need not enter fully because they must be regulated according to the type of angina we have to deal with. We may have to advise one man to become a vegetarian and another to eat meat, but a strict moderation as regards the quantity both of solids and fluids must be prescribed, as we are dealing with a condition very sensitive to fluctuation in blood pressure. For this reason, also, the clothing and climatic surroundings of the patient have to be regulated. Those who in their physical misfortune have the consolations of wealth should avoid the rigours and changes of an unsettled climate by living during the more severe weather in more favoured portions of the globe. Those who cannot do so must, so far as possible, by loose warm clothing, and especially sufficiently warm clothing in bed, endeavour to create that summer in their own surroundings the attainment of which elsewhere their circumstances do not permit them to seek.

As a transitional stage to the consideration of medicinal agents, invaluable in some phases of the disease and useful in others, let us shortly deal with the question of baths and exercises. In connexion with angina pectoris the differences in the operation of these two processes must be borne clearly in mind. Long known and universally employed as has been medical bathing it is to Nauheim that attention has been chiefly directed since Beneke wrote on the effects of hot salt-water bathing on chronic heart disease. His writings on the subject appeared at intervals between 1859 and 1875 and they are those of a cautious and candid observer. He states in a pamphlet

published in 1872[8] that while many of his cases improved after a course of treatment there was little immediate effect observed upon the action of the heart and on the character of the pulse. This observation by Beneke agrees with my own experience as regards cautiously employed warm baths. It is reported of Lord Beaconsfield that, on being asked by an ambassador of his party who had received an invitation to dine with a political club of the Opposition whether he might accept the invitation, the Premier answered, "Why not? a man must dine somewhere." To us sons of the Norse water-dogs, who still smell the brine dashed from the prows of their war ships in the faces of our Viking ancestors, it is at least as desirable that a man should bathe somewhere. And whether he dine or bathe, so long as he do so prudently, the effect is calculated to be beneficial, provided he be not too much exhausted either to eat or to wash. If, when sufficiently able to do either, he do both regularly and systematically for a month or so, and thereafter rusticate in a pleasant atmosphere and take gentle exercise for an additional period far from the madding crowd and the harass of his calling, it would require a very pessimistic person to prognosticate that he would not return refreshed from his holiday to face the duties of life. Such a course of treatment is not calculated to be detrimental to any circulatory disturbance whatever or to any other form of physical debility. In a case of the type in which sclerotic angina frequently occurs and which I examined at Nauheim in 1896, as may be read in my book on "Cardiac Failure and its Treatment,"[9] I found that the vascular changes induced by recumbency in a Nauheim bath differed little from those induced by recumbency on a Nauheim sofa, for the patient visited me at my hotel on the same day upon which I examined him in his bath. I do not wish to imply by this statement that we cannot by manipulating the temperature and contents of a medicinal bath powerfully influence the circulation, but merely that a bath of moderate temperature and of not too irritating constitution, such as is usually employed, is rarely detrimental to any kind of circulatory disorder. My judgment on this point is upheld by the practice at Nauheim to-day, for whereas at one time practitioners there considered that the baths were not suited to arterio-sclerotic conditions they now believe that with circumspection they may in such cases be used without injury to patients. In short, given the presence of organic angina pectoris, the bath which will not injure the patient may be harmless but cannot be rationally expected to be beneficial.

I have had occasion in the course of these lectures to dissent from some of the conclusions at which that distinguished

[8] Zur Therapie des Gelenk-Rheumatismus und der mit ihm verbundenen Herzkrankheiten.

[9] Rebman, London, 1897, p. 129.

French physician, M. Huchard, has arrived as to the nature of angina pectoris. I am glad to find myself at one with him as regards the balneological treatment of this class of case. "It is not necessary," writes M. Huchard,[10] "to share the enthusiasm without doubt disinterested, of the German author who claims to cure true and organic angina pectoris by the help of these waters. I have seen, indeed, some of his patients really cured, but they were cases of false angina of which the precise diagnosis had not been established and which ought to have been cured by any other means. I also saw a case of true angina who, curiously, resisted a species of therapeutic suggestion exercised upon him and who returned to France in considerably worse plight. This pseudo-success is not to the credit of the waters of Nauheim." But the case is far otherwise with the exercises whether mechanically or manually administered and which are at times of much service in appropriate cases of cardiac debility or disordered compensation in valvular diseases of the heart. Of these methods there can be but little doubt that the Swedish resisted movements systematised and regulated in their application to cardiac cases by the late Dr. August Schott are the safest and best. But be they never so safe and never so good in suitable cases, the increase in the force of cardiac systole which results from their employment places them entirely out of court in the treatment of any but the most innocuous forms of angina pectoris. Remembering the possibility of the occurrence in coronary angina of such an aneurysm as I have demonstrated to you, I ask whether any rational being would advise any resistance movements in such cases with the knowledge that such a lesion may underlie the manifestation of pain. I place no mark of interrogation after this sentence for it requires no answer. An occasional anginous attack in one probably the subject of fatty heart may not, perhaps, be capable of being placed in the same category as those I have referred to, but the advisability of either baths or exercises even in such a case, provided there be evidence of the attacks having been indicative of an organic basis to the symptom, is highly questionable.

If on account of a possible aneurysm in connexion with angina exercises of the kind mentioned be contra-indicated, what is to be said of complete rest? We know that angina may occasionally be a troublesome symptom in aneurysm of the aorta; we know also that absolute rest, especially if associated with a reduction of the quantity of the food taken, on the lines practised by Tufnell of Dublin, has resulted in amelioration of the symptoms due to aortic aneurysm. Would these results indicate the employment of a similar line of treatment in cases of coronary angina even if we had the means of determining positively that the physical basis of the disease was aneurysmal? There is no

[10] Maladies du Cœur et des Vaisseaux, p. 420.

doubt that complete rest is less frequently associated with attacks of the pain than activity. The conditions of the blood pressure, therefore, in this state are more equable than during movement. On the other hand, the patient, possibly a gouty man and but for his attack a healthy man, condemned to his couch for an indefinite period, would be quite likely in his enforced inactivity to manifest signs of his constitutional taint. If we grant that with careful supervision and a restriction of food to the necessities of his body such a disturbance as an attack of gout be avoidable, could an attempt to induce coagulation in the very small sac of an internal coronary aneurysm be brought about without the greater evil of a coronary thrombosis? In discussing the prognosis of angina pectoris Dr. Osler[11] states that "recovery is quite possible, and there are instances in which the attacks disappear entirely," but, unfortunately, the instance he mentions was but an angina symptomatic of lost compensation in aortic valvular disease. That such recover with the restoration of compensation in many cases we know. I am not aware, however, that there is any record of the recovery of a case of coronary angina, even though it may have been slow in development and compatible with life for a lengthened period. It is theoretically possible that a small and even dissecting internal coronary aneurysm might so thicken and shrink as to become practically obliterated with or without blood coagulation in its interior, but such a case has to be found before this supposition can be substantiated. That it has not been found may, perhaps, be due to its not having hitherto been sought for or suspected to exist. I have urged these theoretical objections against complete rest in coronary angina that I might not appear to lose sight of the collateral evils which may attend any special course of treatment. But were the dangers of coronary thrombosis in the circumstances very great, they might be equally urged against the treatment of aortic or of any other aneurysm by this method, for coronary disease might be coincident with these, and the occurrence of coronary thrombosis would probably bring about the death of the patient. If, therefore, much judgment would be required in instituting treatment by complete rest in the early stages of a coronary angina there need be no hesitation in asserting that in its later phases as indicated by an increase in the frequency of the paroxysms, rest is the only rational treatment of the disease. It is calculated to postpone as long as may be the final scene, and it is not impossible that by some fortunate accident it might induce greater defensive powers in the artery which might cure the patient. The possibility of such a cure we may admit; the prospect of it we are not at present justified in holding out to our patient. The fear of inducing thrombosis by recumbency in the coronary arteries need not,

[11] Op. cit., p 139.

however, deter us from instituting such a treatment, for, as Dr. G. W. Balfour has pointed out, the coagulation of blood, even in aneurysmal sacs of large size, is not easily brought about during life, and improvement when it occurs under rest and the use of iodide of potassium appears to be induced rather by a thickening and shrinking of the walls of the aneurysm than from coagulation within it.[12] In the internal coronary aneurysm I have shown you the blood coagulation in the lumen of the artery and that in the sac were evidently both of about the same age and probably both occurred either in the act of death or very shortly before it.

The drug treatment of angina pectoris is divisible into (1) the management of the paroxysm of cardiac pain and (2) the medicinal treatment of the patient in the intervals between attacks.

1. *The treatment of the paroxysm.*—The mine once laid, be it in coronary, cardiac, or aortic lesion, the spark necessary to its explosion is, in a large number of cases, exaggerated blood pressure, whether direct and propulsive from the heart or indirect and obstructive from the peripheral arterial system. This is probably the case in all save the musculo-spasmodic and musculo-paretic or syncopal cases. It follows that in most cases the regulation and moderation of blood pressure are the primary objects which the physician has in view when he prescribes a medicinal agent to remove the injurious effects of excessive vascular pressure. Concurrently with these it may be also necessary on occasion that he should employ more direct analgesics, and in the final stage, if need be, one form or another of artificial respiration or cardiac stimulation, to which reference may now be made. Cardiac failure in angina pectoris being primary or due to vagal inhibition, as has been maintained, the employment of Laborde's method of rhythmical tongue traction[13] in combination with Silvester's method of artificial respiration is indicated. In the profound and prolonged syncope observed in the status epilepticus I have repeatedly found Laborde's method apparently very efficacious. Laborde's own explanation of the *rationale* of this procedure seems sufficient. He attributes its efficacy in great measure to the stimulation by tongue traction of the lingual fibres of the superior laryngeal branch of the vagus and to the cardiac and respiratory reflexes thus provoked. The combination of artificial respiration with tongue traction, which might be termed the Silvester-Laborde method and for which the coöperation of two persons is necessary, would most completely fulfil the indications in anginal syncope. But the direct heart-stab of angina pectoris which has reached the final stage of cardiac inhibition will probably

[12] Lectures on Diseases of the Heart, p. 467.

[13] Les Tractions Rhythmées de la Langue, &c., par J. V. Laborde, Paris, 1894.

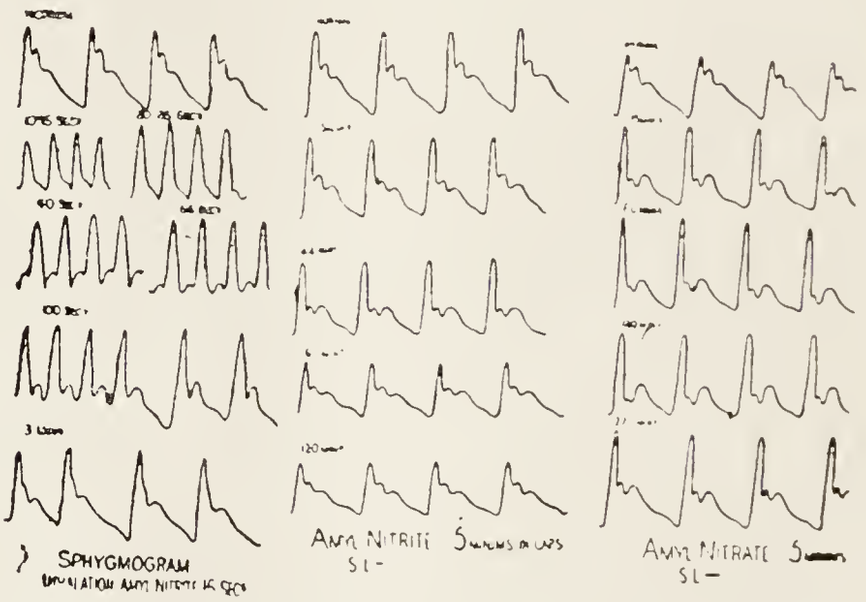
prove more hopeless of recovery than syncope from other causes. There is no valid reason, however, why perseverance should not occasionally be rewarded in these circumstances as well as in others in which such persistent efforts to restore animation have been successful.

The most powerful influence in counteracting the paroxysm of angina pectoris must be ascribed to the *nitrites*. Nitrite of amyl, the vaso-motor influence of which was originally determined by Guthrie in 1859,[14] was first used in the treatment of this disorder by Lauder Brunton in 1866. Whatever difference of opinion may be entertained regarding the physiological mechanism of angina pectoris there can be none concerning the frequent efficacy of the nitrites in relieving cardiac pain. In 1879 Murrell[15] enriched our therapeutic armoury by using nitro-glycerine in the treatment of angina pectoris and Matthew Hay in 1883 used nitrite of sodium for the same purpose. One of the best general accounts of "the pharmacological action and therapeutic uses of the nitrites and allied compounds" which has appeared in the English language is that given in his Croonian Lectures by the late Dr. D. J. Leech[16] of Manchester. The scope of my present lectures precludes a digression into the very interesting pharmacological and physiological phenomena revealed by a study of the effects upon the circulation of the nitrite group of medicinal agents and I cannot do better than refer those who wish to peruse a masterly treatment of the whole subject to the lectures of Dr. Leech, an observer whom medicine could ill spare. There are, however, some points in connexion with the comparative celerity with which these drugs act and the length of time for which their effects last which are of practical moment in the treatment of angina pectoris. These points have been well summarised by Dr. Leech[17] in the following words: "Changes in arterial tension are not often indicated by subjective phenomena and their extent and duration can only be measured by the sphygmograph. With this instrument I have tried by means of tracings taken frequently to estimate the time at which it reaches its lowest point and its duration. The influence of amyl nitrite on the pulse commences a few seconds after inhalation (Fig. 12). The tension is reduced to its lowest point in from 50 to 60 seconds and remains extremely low for 30 or 40 seconds, the pulse waves being reduced in size and sometimes irregular. Then it rises again, occasionally suddenly, and in from a minute and a half to two minutes

[14] The Quarterly Journal of the Chemical Society, London, 1859.
[15] THE LANCET, Jan. 18th (p. 80) and 25th (p. 113) and Feb. 1st (p. 151) and 15th (p. 225), 1879; and Nitro-glycerine in the Treatment of Angina Pectoris, London, 1882.
[16] THE LANCET, June 24th (p. 1499) and July 1st (p. 3), 8th (p. 76), 15th (p. 123), and 22nd (p. 177), 1893.
[17] THE LANCET, July 1st, 1893, p. 3.

the pulse is only a little lower in tension than it was before the inhalation. The slight lowering may continue for several minutes. Isobutyl and isopropyl nitrites when inhaled act almost like amyl nitrite. Sir B. W. Richardson, to whom we are so much indebted for knowledge concerning amyl nitrite, has drawn attention to the fact that when it is taken internally its effects are much slighter though more prolonged than when inhaled. Instead of the tension falling at once and recovering in two minutes' it falls gradually for usually 20 to 25 minutes, remains low a short time, and then rises to its normal height an hour to an hour and a half after the dose has been taken. Because amyl nitrite is such a powerful agent when inhaled one drop is

FIG. 12.



Tracings showing the relative effects of (1) the inhalation and (2) the internal administration of amyl nitrite; and (3) of the internal use of amyl nitrate. The upper tracings are the normal, the lowest after the lapse of a considerable period (one and half to three hours), and the intermediate of the effects of the drugs from 10 to 100 seconds after the exhibition (Leech).

regarded as the proper dose but this is a mistake; from three to five minims may be required to produce about the same effect as that which follows two grains of sodium nitrite. A small dose of sodium nitrite (two grains) distinctly affects the pulse in two or three minutes; the point of lowest tension is usually reached in from eight to 40 minutes and distinct influence on tension ceases in one to three hours. Ethyl nitrite has much the same effect and on the whole lasts as short a time." The sphygmogram which I have copied from Dr. Leech's third lecture [18] illustrate some of these points (Fig. 12). The tracing which

[18] THE LANCET, July 1st, 1893, p. 5.

I also now show you from the pulse of the patient suffering from angina whose case I have related illustrates the effect on the pulse of the nitrites (1) in an interval between attacks and (2) during the attack (Fig. 8). They were published in *Treatment* of Oct. 14th, 1897. A shows the character of the pulse when the patient was free from pain and not under the influence of trinitrin. A dose of trinitrin was then administered to him with the results shown in B. The upper of the two tracings in this figure shows the acceleration of pulse and depression of pressure characteristic of the action of the nitrite on a pulse not under the irritative influence of pain and its gradual rise of pressure as the accelerant influence of the drug passes off. C shows the character of the pulse taken after an attack had just passed off and during which no trinitrin was taken. In D the lower of the two tracings exhibits the quick, small, hard pulse characteristic of some cases of angina which may be instructively compared with the unirritated yet accelerated pulse due to the action of trinitrin in the absence of pain, as shown by the upper tracing in B. The upper of the two tracings in D is characteristic of the pulse when an attack of angina, combated by the use of the nitrite, is passing off. With these tracings from a classical case of Heberden's disease we may also profitably compare those I have already shown you when discussing the *rationale* of endocardial angina and which are from a case of regurgitant disease of the aortic valves. They show the small, accelerated, low-tension pulse of some cases and the gradual rise of pressure in the pulse as pain passes off and the artery is filled under the influence of the nitrite (Fig. 9).

As a rapid action of the drug is desirable during an attack of pain the inhalation of the nitrite or the internal administration of trinitrin in a fluid form is indicated. Of these the method by inhalation is more prompt in action and is to be preferred in the circumstances. Nor need we fear the use of more rather than less than the conventional dose of five minims of nitrite of amyl, for it has, accidentally and intentionally, been demonstrated over and over again that although a very small quantity of this drug has a physiological and therapeutic effect, very large quantities have been inhaled and used without persistently ill effect. Even the 1 per cent. solution of nitro-glycerine may be taken by some patients in considerable doses, though others can only tolerate small doses. Dr. Murrell mentions a case which took 100 minims of the solution as a dose, while another suffered severely from half a minim.[19] I generally use two to five minims and the only inconvenient consequence I have noted has been some degree of headache. The dioxidation of the blood under the influence of the nitrites may be disregarded for therapeutic purposes as the effect of these

[19] Op. cit., p. 71.

drugs is very evanescent. But gratifying as is the result of the use of the nitrites in many cases of angina they do not by any means always succeed in relieving the patient. The agony may continue notwithstanding their free use. In these circumstances, placed as we are between the possibility of witnessing a fatal inhibition or syncope and our own fears lest we should use too powerful an analgesic, we must run some risks if necessary to arrest an almost certain catastrophe if the pain should continue. Our sheet anchors then are chloroform, with or without the subsequent or combined use of ether and the hypodermic injection of morphia. On confronting such a situation Dr. G. W. Balfour writes as follows [20]: "In a few cases the relief obtained (by the use of nitrites) is sudden and complete; more often the relief that follows is gradual and doubtfully due to the treatment, while in a few cases no relief seems to follow even the most prodigal use of these drugs. Then we are forced to have recourse to the free administration of chloroform and this must be given so freely as to narcotise the patient rapidly and completely; given in this way I have not seen any case that has not been relieved, though I have seen several in which the relief has not been permanent enough to restore the patient to comfort. In these cases the chloroform has had to be supplemented by the hypodermic injection of morphine, and of this I have never hesitated to give a sufficient dose, generally from half a grain to a whole grain; such a dose as this has kept the patient asleep for some hours and he woke free from pain but exhausted." In view of the opinion which I strongly hold, that in the fatal issue of painful angina inhibition of the heart exercised by way of the pneumogastric nerve plays an important part, it is desirable that the use of atropine should be combined with the employment both of the nitrites and opium and other remedies—indeed, that it should always be used in these cases. For we know that, experimentally, the inhibitory function of the vagus is placed in abeyance by the use of atropine and its influence in small doses upon the heart is at once to accelerate its rate and augment its force. I should add that Dr. Leech disapproved of the use of morphia. Even in the later stages of angina he states that increased doses of liquor trinitrini up to 20 minims is a safer proceeding.[21] The method, degree, and rapidity of anæsthetisation must, however, be gauged in each case. It may safely be stated that the experience of no one man will include a very large number of cases of organic angina pectoris (other than those connected with valvular disease) requiring such extreme measures. Personally I have only met with three such. Stokes, one of

[20] Lectures on Disease of the Heart, third edition, London, 1898, p. 331.

[21] THE LANCET, July 15th, 1893, p. 124.

the founders of cardiology, if we may use the term, confessed, as I have stated, that he had never seen even a mild case of angina other than that kind of cardiac pain associated with valvular lesion, and this will rarely require such vaporous anæsthetics as chloroform, although it may often require the hypodermic injection of morphia in addition to the use of the nitrites. This combination has also been found useful by Huchard. In short, cardiac failure, threatened by cardiac pain, is to be treated on the same lines as cardiac failure threatened by hepatic, renal, or any other form of physical suffering. It must be remembered, moreover, that the angina associated with valvular disease (usually aortic) is frequently in direct ratio to the degree of non-compensation in the ventricle and that production or restoration of compensation is the only road to a permanent removal of the angina. While, therefore, the important but engrafted symptom of cardiac pain must receive attention the underlying cause—non-compensation—must not be lost sight of. To treat this well in cases of aortic regurgitation requires much judgment and experience.

The drug treatment of angina pectoris in the interval between attacks.—Because the depression of blood pressure by the nitrites relieves the pain of angina, owing in great measure to their vaso-dilator effects, it is rational to believe that had we some agent which could for a longer period maintain such a vascular state a greater immunity from the recurrence of such attacks might be secured. Professor J. B. Bradbury of Cambridge reasoned thus when he gave his Bradshaw Lectures in 1895.[22] That we may stave off an attack of angina by a timely dose of nitrite when a patient is about to perform some act likely by a rise of blood pressure to induce one may be admitted, but before regularly employing vaso-dilators which are less evanescent in their action than the nitrites we have to consider whether high arterial pressure as such is the cause of angina. That a habitually high-pressure pulse may be one of the causes of the atheroma and its consequences, of which angina may be the expression, can scarcely be doubted ; but the actual cause of anginous attacks, the mine, as I have said, or local lesion once existent, seems to be less an equably high blood pressure than an irregular or intermittent one. To quote Heberden again, "Those who are attacked by this disease are wont to be seized with the most severe breast-pang while walking. ..... As soon, however, as the pace is arrested all distress is quieted in a moment (*totus angor momento conquiescit*)." Heberden's words perhaps convey the impression of a more rapid disappearance of pain on the cessation of those actions which induce them than always takes place, but they also establish the fact that it is the sudden or intermittent rise of blood

[22] The Lancet, Nov. 16th, 1895, p. 1205.

pressure—it is, so to speak, the *blood stroke* rather than the blood pressure—which induces the pain, for the average blood pressure, even if it be high, is doubtless maintained in some such cases after the attack has passed off. When relief is observed in some cases of angina pectoris on the establishment of an apical bruit, indicating incompetency of the mitral valve, it is probably due not only to diminished blood pressure at the periphery, but also to lessened systolic impulse and perhaps to slightly diminished ventricular output. I am aware that in arguing thus I impugn in such cases the correctness of the theory of cardiac ischæmia. If, however, my argument be correct what we have to arrive at is securing an equable pressure, so far as possible, not necessarily a low pressure. The constant normal variation of pressure renders this object only partially attainable and this fact adds to the pity with which sufferers from angina must ever be regarded, for they carry as a condition of very life an enemy in their bosoms whose onslaught may be delivered at any moment and whose stroke cannot altogether be avoided even by the greatest watchfulness.

The higher nitrates, chiefly those of erythrol and mannitol, which Professor Bradbury recommends as more persistent vaso-dilators than the nitrites, have not come into general use, and it is perhaps questionable whether they are likely to do so. Sir Lauder Brunton's explanation of the *modus operandi* of the nitrites—namely, that they have a paretic influence upon vascular muscle—has been very generally adopted and Dr. Leech also satisfactorily showed in his Croonian lectures that the final, if not initial, action of these drugs upon the heart itself was of the same character. The nitrates, although not acting so powerfully as the nitrites, act in the same way and the continuous employment of a cardio-vascular depressant is not calculated, on theoretical grounds, to be permanently beneficial. Dr. G. A. Gibson, however, writes :[23] "From the few observations which have been allowed me since the drug (erythrol tetra-nitrate) was brought forward no doubt has been left in my mind as to its value. Although somewhat less rapid in its effects it is much more persistent" (than the nitrites). Indeed, in some cases of failing heart with low tension and angina we are compelled circumspectly to use strophanthus. My own practice when this is necessary is to combine it with aromatic spirit of ammonia and spirit of nitrous ether. The ammonia, as Dr. Leech states,[24] retards the decomposition of the nitrous ether, and the nitrous ether tends to control the action of the cardiac tonic. This theory may be erroneous, but I have found the combination at times to act well in practice. Digitalis given alone is frequently found to aggravate matters in sclerotic cases manifesting angina.

[23] Diseases of the Heart and Aorta, p. 782.
[24] The Lancet, July 22nd, 1893, p. 178.

To secure, so far as possible, an equable blood pressure we must avoid as well as employ certain drugs. In this sense tobacco is a drug calculated to raise blood pressure and should theoretically be altogether avoided. The physician will, however, have to judge of the advisability of recommending this step by the character and circumstances of individual cases. To deprive a man long used to the solace of tobacco of his "smoke," if he be not a stoic, may be to precipitate rather than to obviate angina. But in any case permission to smoke must be inexorably limited to that minimum which will secure mental as well as vascular equability. We must also endeavour to remove indirect causes of vascular tension. We have been taught by physiologists the value of the play of neuro-vascular action in the splanchnic area as a safety-valve to threatened excess of vascular pressure elsewhere, and the use of certain agents which combat fermentation and promote the flow into the primæ viæ of the natural secretions which secure a normal blandness of intestinal content is of the first importance. Among such agents I should place in the first rank the milder mercurials—calomel and blue pill. I have cardio-vascular patients who have taken from half a grain to one grain of calomel once or twice a week regularly for a twelvemonth at a time, with unquestionable benefit in maintaining an equable blood pressure. This practice on my part is no recent procedure but I did not derive it from my *alma mater*, the University of Edinburgh, for when I was in my professional infancy my clinical teacher, one of the ablest who ever felt a pulse—the late Professor Hughes Bennett—had, perhaps, among some dislikes one prime aversion—namely, mercury in every form. So that I began practice fully convinced that, did I prescribe that drug to my patients, I should shortly have around me a tremor-struck and gibbering public execrating me as the mercurialised prisoners in a quicksilver mine might their gaoler. From this delusion I was freed many years ago by the distinguished physician who is the President of this College and whose views on the beneficial effects of wisely administered mercurials in securing an equable blood pressure are now so well known. How mercurials act in these circumstances, whether as eliminants, as Sir William Broadbent suggests,[25] or as antiseptics, or as more direct vaso-dilators, it is not necessary for practical purposes to inquire. Their action is, without doubt, frequently beneficial in maintaining a certain softness and pliancy of pulse for long periods. General gastro-intestinal medication by alkalies or acids as required, or by the use of saline or other aperients, is indicated for the same reason—namely, to remove or to correct possible causes of intermittent blood pressure of an injurious character. It is possible that some of the good repute enjoyed by iodide of

[25] The Pulse, 1890, p. 182.

potassium in cardio-vascular sclerosis may be due to its efficacy in cases of specific origin, but such a supposition does not account for its general use by observant physicians. Although the drug had some vogue in such conditions before the advocacy by Dr. Balfour of its usefulness, there can be no doubt that his emphatic and authoritative utterances in its favour have done much to secure its general adoption as a cardio-vascular remedy or agent in treatment. He compares its action in one place to that of the nitrites[26] and in another refers its therapeutic effects in aortic aneurysm to the reduction by it of intra-arterial blood pressure.[27] The dose he recommends for continuous use as a vaso-dilator is two grains every 12 hours. The one objection to its employment has perhaps more weight in cases of angina pectoris than in cases not associated with these paroxysms—namely, its tendency at times to cause gastro-intestinal irritation and thus to provoke those reflexes which induce irregularities in vascular pressure. But the same objection applies to mercurials, and if the administration of both these useful agents be coupled with a scrupulous care as to the blandness and sufficiency of diet and the avoidance of condiments such as vinegar, ketchups, and effervescent wines and beverages, this objection is in no way comparable to the advantage which is constantly derived from their use in the intervals between attacks of angina. Concerning the *modus operandi* of the iodides in inducing a more equable vascular tone there is room for legitimate differences of opinion, for much obscurity attends our present knowledge of the subject. We must be content, meanwhile, to act empirically so long as our action is beneficial to the patient and wait for that enlightenment which science sooner or later affords those who industriously look for it and patiently expect its advent.

Drugs other than powerful analgesics and vaso-motor agents may be of service in some cases of angina. If the malady be associated with anæmia due to some specific cause such as malaria, or be attributable, as appears to be the case in some instances, to lead poisoning, or be aggravated by defective blood states of the kind more commonly met with, the treatment of the accidental state, *secundum artem*, by such agents as arsenic or iron or iodide of potassium, as the case may be, is calculated to be of benefit. In functional or inorganic cases they may be all that is necessary to effect a cure when coupled with attention to general hygiene.

What has been said as regards the treatment of angina pectoris applies in the main to the treatment of angina sine dolore or syncope trepidosa. As Dr. Leech has remarked, although the ultimate influence of the nitrites on the cardiac muscle is depressant, it is probable that by inducing a larger number of smaller contractions the nitrites

[26] Op. cit., p. 379. [27] Op. cit., p. 467.

help to unburden an overladen heart, even if the individual contractions be less powerful than normal.[28] But in the syncopal variety of the complaint, if we still classify it with Heberden's disease, hypodermic injections of strychnine find appropriate and, at times, life-saving employment. M. Huchard has well remarked[29] that in some severe cases of painful angina the pain itself is the best safeguard against an overdose of a direct analgesic like morphia. So, also, it may be equally cogently maintained that in painless or syncopal angina the syncopal state is the best antidote against the injurious influence of a somewhat bold use of strychnine. With this powerful agent we may usefully combine, as in the case I have related, the tincture of strophanthus, which acts as powerfully on the heart as the preparations of digitalis and is less likely than the latter to raise a peripheral obstacle to the circulation as it acts less on the distant arterioles. Such a combination may be to syncopal angina what opium, chloroform, and atropine are to painful angina of a severe type.

We have now discussed with such fulness as the limits of our time will permit the nature, causes, and treatment of cardiac pain. Great as still is the obscurity of many important questions which are raised by a study of Heberden's disease, the retrospect of our progress in the knowledge of angina pectoris since he wrote in so masterly a manner is not discouraging. The ever-compelling future which justifies and renders interesting the present may be confidently predicted to show no lessening of the rate of progress which the last century has exhibited; and it does not require the vision of the seer to predict that much that is still a sealed book to us in the matters we have been considering will a century hence or sooner be common knowledge. But that this devoutly to be desired end may be reached thought must ever be the handmaid of observation and we must be careful to rear the superstructure of our conclusions on the rock of patiently verified fact.

[28] Croonian Lectures, THE LANCET, July 24th, 1893, p. 1505.
[29] Op. cit., p. 676.

Printed at The Lancet Office, 423, Strand, W.C.